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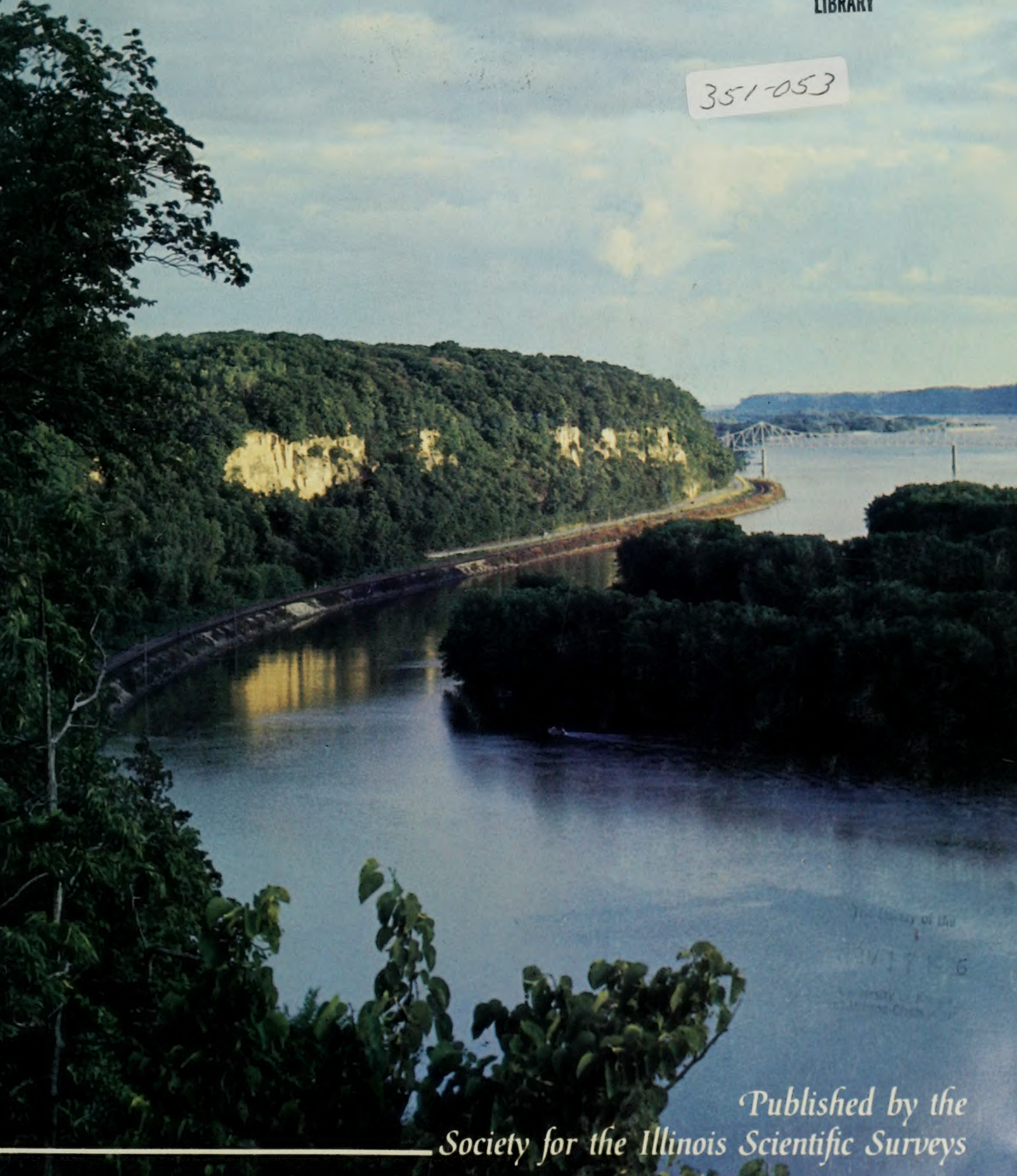

Published by the
Society for the Illinois Scientific Surveys

The Society Page

Welcome to the Society for the Illinois Scientific Surveys. And welcome to the first issue of *The Nature of Illinois*, published by the Society for the Illinois Scientific Surveys.

The Society came into being in 1984 as a not-for-profit corporation. Its purpose is to promote, foster and encourage the welfare and programs of the three Illinois Scientific Surveys - The Natural History, Water and Geological Surveys.

I first became acquainted with the Surveys through the Natural History Survey's efforts to save the Illinois prairie chicken from extinction. In my younger days I remember seeing flocks of a thousand or so, but by the 1950's there were only a few flocks of very small numbers. With the help of some conservation-minded people and the Natural History Survey, we were able in one way or another to establish some sanctuaries. The system now has expanded to two separate flocks in different counties.

The Surveys fell on hard times in the mid-1970's when they lost all of their cars, and their travel budgets were limited to $1,000 each. This situation was remedied in part by Governor Thompson in his first year of office when he restored the Surveys' travel funding to normal levels. Later the Surveys were moved into the newly-formed Department of Energy and Natural Resources (ENR), a natural home for research agencies like the Surveys.

The biggest problem facing the Surveys then, and now, is that they are not really understood, recognized or appreciated by many people in our state. The idea of a group of lay people to act as friends of the Surveys had great appeal to the Survey Chiefs, to Mike Witte, former Director of ENR, and Governor Thompson. Having served on the Board of the Smithsonian Institution Associates, I could see a parallel with the Surveys, and I agreed to serve as Chairmen of the Society's Board of Directors.

We have made great progress. We have enlisted an active and involved Board of Directors with members from all parts of the state. We have hired a full-time Executive Director. And we have begun work on educational, corporate and communication programs to get the invaluable work of the Surveys out before the public of Illinois.

I hope you will enjoy the first issue of *The Nature of Illinois*. And if you or your organization is not already a member of the Society, I hope you will consider joining us.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

Staff

Jane A. Bolin
Executive Director

William Rooney
Communications Consultant

Linda Classen Anderson
Assistant Director

Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 2021 Illini Road, Springfield, IL 62704

The Society encourages readers to submit letters to the editor of *The Nature of Illinois* at the address above.

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The Nature of Illinois

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A DEEP HOLE

In Southern Illinois

Jules Verne wrote Voyage to the Center of the Earth *in 1864. One hundred twenty-two years later the scientists at the Illinois State Geological Survey are proposing their own version of Verne's masterpiece, a superdeep drillhole penetrating to a 6-mile depth in southern Illinois.*

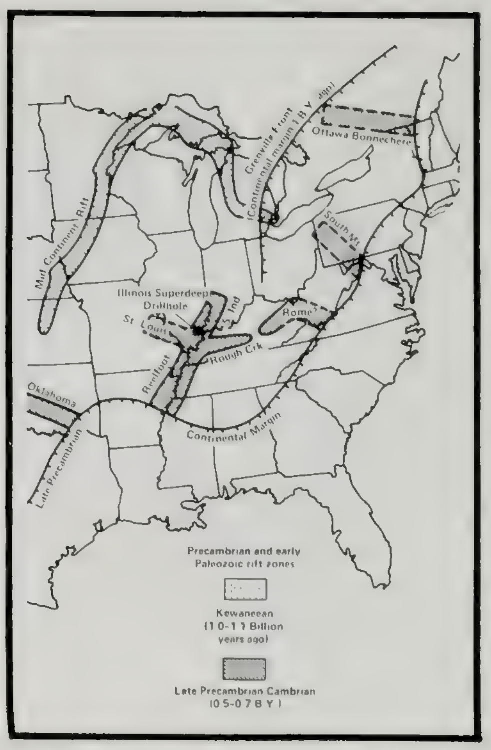
A continental scientific drilling program was conceived by a group of U.S. scientists at Los Alamos in 1978. Two years later a Continental Scientific Drilling Committee (CSDC) was formed under the auspices of the federal government to study U.S. continental drilling targets. Priorities for a national program of deep holes were published by that committee in 1984.

At that time the probable U.S. target was a 10-kilometer hole in the Appalachian mountains near the common boundaries of Georgia, North Carolina and South Carolina. Subsequently, Deep Observation and Sampling of the Earth's Continental Crust (DOSECC) was incorporated and approved by the National Science Foundation as the corporation to carry out the scientific drilling program. DOSECC spread its drilling net farther afield and entertained 32 deep hole proposals at an April 1985 workshop in Houston.

The Illinois Superdeep Drillhole

One of those 32 proposals was a collaborative effort presented by the Illinois State Geological Survey on behalf of about 96 principal investigators, six state agencies, one federal agency and 43 universities. The proposed Illinois Superdeep Drillhole (ISDS) is slated to drill 20,000 feet of Illinois basin sediments at the deepest part of the basin in southern Illinois. The hole would then be continued 10,000 feet deeper into crystalline basement rocks. Southern Gallatin or northern Hardin County is the likely site.

The Illinois Basin can be envisioned as a stack of spoons with handles pointing down the Mississippi River toward the Gulf of Mexico. The spoons represent the sediments in the basin, which are 20,000-feet thick in the vicinity of the handles. The handles represent the Reelfoot Rift, a faulted or rifted region southward. Other faulted arms or rifts extend from the base of the spoon, northeastward into Indiana, eastward into Kentucky and northwestward into Missouri.


Mid Continent Rift
Grenville Front
(Continental margin 1.8 B.Y. ago)
Ottawa Bonnechere
South Mt
Illinois Superdeep Drillhole
St Louis
Ind
Rome?
Rough Crk
Reelfoot
Oklahoma
Late Precambrian
Continental Margin
Precambrian and early Paleozoic rift zones
Kewaneean (1.0-1.1 Billion years ago)
Late Precambrian Cambrian (0.5-0.7 B.Y.)

Why a Deep Hole?

Jim Eidel, Principal Geologist and Head of the Mineral Resources Group of the Illinois State Geological Survey, has been an active participant on the Continental Scientific Drilling Committee since 1981 and was the prime mover in getting an Illinois deep-hole effort started.

"We've studied the ocean floor extensively and ignored the continents," Eidel said. "The Illinois core hole is probably the most scientifically comprehensive proposal that I've heard during my years on the Continental Scientific Drilling Committee. It addresses a large number of important scientific questions."

"First, this area of southern Illinois is the juncture of ancient rift systems, continental sutures if you wish, which constitute the structural breaks where earthquake activity can be expected in this region. If you're going to study how the continent was put together—which is the main thrust of the continental scientific drilling program—this is a unique place to start. It's a triple or quadruple junction of ancient continental rifts."

Eidel points out that the New Madrid earthquake in the Reelfoot Rift had an extremely wide area of disturbance in the United States because the flat-lying rocks underlying the central United States transmitted the shock waves far afield. The Appalachian area and the western United States by comparison are made up of strongly folded rock that transmits the energy created by an earthquake much shorter distances.

The focus of the 1811-1812 New Madrid earthquake was in the northeast trending Reelfoot Rift in the Bootheel region of Missouri. The New Madrid earthquake rattled dishes in Boston. Less intense earthquakes occur near the proposed deep-hole location every year.

The data gathered by the ISD on how the continents are put together and how the structures in the midcontinent are interrelated will provide valuable background data for scientists studying earthquakes in this area.

A second practical application of the deep-hole relates to oil and gas and mineral resource exploration. According to Eidel, about 4,000 feet of sediment that has never been seen before will be drilled. Those 4,000 feet will give scientists their first chance to study the hydrocarbons that remain in those rocks, a potential source of petroleum or gas. More importantly, they may suggest where to look in the deeper portions of the Illinois Basin for oil and gas. The study of brines in the deep-hole may also provide information on the origin of Illinois fluorspar deposits and could generate renewed interests in southern Illinois fluorite, lead zinc and rare earth metals.

Finally, the deep-hole has important implications for pure scientific research. What is known about the deep continental crust is based on geophysical measurements—gravity, magnetics and electrical measurements taken from the surface of the earth and projected to depth. What scientists don't have are physical measurements at depth with which to equilibrate these surface-generated measurements. A drillhole at this depth will give them the first hard data on physical properties at these depths and solid information on which to base crustal models. That in turn will give them a chance to project new measurements even deeper into the earth.

The Russian Kola Hole...and Others

To date, the deepest core hole in the world is a Russian core hole. The Russians have drilled to more than 40,000 feet on the Kola Peninsula over a period of 17 years. Last September the Russians began drilling a 9-mile hole near Krigoy Rog in the southern Ukraine. The Soviet Union views its efforts as part of an intensive push to learn more about the mineral resources that lie below its territories.

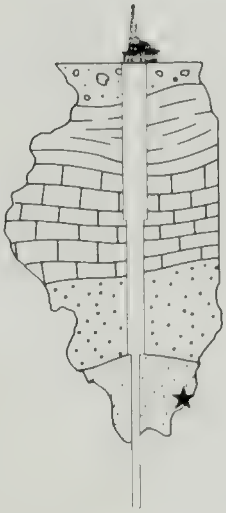
Playing catch-up with the Russians is part of the deep-hole game too. American scientists are confident that American technology can out-drill the Soviets. The Soviets' efforts are considerably slower than those envisioned by American drillers because the Soviets must pull all the drill pipe out of the hole each time they take any rock from the bottom. It takes them more than 18 hours to pull all the pipe out, remove the core, change the bit and put the pipe back in the ground. American technology is being geared toward taking the rock out of the hole without taking all of the pipe out.

Other countries are getting in the game too. The Germans have allocated $140 million to drill a deep hole that will be deeper than the Russian hole and are in the process of active design. Sweden, Austria, Japan, Canada and other countries are also in the process of developing continental scientific drilling programs.

The deepest oil well in the United States is 32,000 feet deep. Oil wells, however, are drilled with rotary cones that grind the rock into very small chips, destroying much of its value for scientific purposes.

The proposed Illinois hole will provide a continuous cylinder of rock and could be completed in as little as two to three years.

ILLINOIS SUPERDEEP DRILLHOLE



ILLINOIS STATE GEOLOGICAL SURVEY

What a Hole Costs

The budget for the Illinois hole is roughly estimated at $32 million. Funding will most likely be found through the National Science Foundation (NSF), though the NSF now has monies only for planning, shallow drilling and deepening of existing holes. There is a Continental Scientific Drilling and Exploration Act introduced in the Senate by Senator Pressler. That Act calls for the National Science Foundation, the U.S. Geological Survey and the U.S. Department of Energy to recommend maximum and minimum budgets. Private corporations may also be approached for funding.

In the meantime, efforts in Illinois are being directed toward the preparation of a detailed scientific proposal. DOSECC chose the Illinois Superdeep Drillhole as one of the eleven sites meriting further work. A four-day workshop, sponsored by DOSECC, the Illinois Department of Energy and Natural Resources, the Illinois Environmental Protection Agency and others, is being organized by the Illinois State Geological Survey.

Mr. Jim Eidel is Principal Geologist and Head of Mineral Resources at the Illinois State Geological Survey. Eidel was U.S. exploration manager for the Coastal Mining Company until last February, when he joined the Survey. He has been a member of the Continental Scientific Drilling Committee of the National Academy of Sciences/National Research Council since 1981 and chaired the CSDC Panel on Mineral Resources Creede target, which received initial DOSECC drilling funds this year.

A PATTERN

Just as human civilizations rise and fall over long periods of time, so do plant and animal communities in the world's large rivers. The phenomenon, known as "succession," and others, are being studied in the Illinois and Mississippi rivers by an interdisciplinary team comprised of the Illinois Natural History, the Illinois State Water Survey, the Illinois State Geological Survey, the Illinois State Museum and Western Illinois University.

The National Science Foundation-funded Long-Term Ecological Research (LTER) project is destroying old myths about the ecosystems and the very nature of the Illinois and Mississippi rivers themselves.

"The old view was that rivers are just pipes that carry things down to the sea, and aquatic animals are dependent on what falls in upstream for food," according to Dr. Richard Sparks, Aquatic Biologist at the Illinois Natural History Survey. "Actually, rivers generate much of their own food, although they do make use of organic material from upstream. The river is a whole world to itself, not just the drain for a land area."

What the researchers found in studying the flow patterns of the river surprised even them. The traditional view of material in the water moving from upstream to downstream gave way when Water Survey teams found an oval eddy, three-fourths mile across and 3 miles long, rotating very slowly along the border of the main channel of the river. This water mass held suspended sediments and nutrients for 20 to 36 days over the area instead of the few hours traditionally thought by biologists.

That extended time period had important implications for the river's ecological life. Animals and plants were *not* losing food and nutrients downstream as had been previously thought. The researchers found that aquatic communities were producing their own food. Water plants were growing, decaying and being broken down by bacteria and fungi into the small particles called "detritus." Detritus in turn fed the animal life at the bottom of the river.

IN TIMETIME

The detritus generated in the plant beds was also feeding the animals offshore. The eddy's flow pulled organic material out of the plant beds and distributed it over a large area.

LTER team scientists believe that a similar phenomenon exists when summer windstorms and surges from barge traffic redistribute detritus over large area of the river. This summer the team will attempt to capture wind and barge events and measure the amount and distribution patterns of detritus.

The most significant long-term event the researchers found occurred in Pool 19 (the Keokuk pool), once a rapid several miles long. In 1913 the rapids were dammed into a pool, with a gradual evolution from a rocky bottom to a silt bottom as the sediment fell out. It was here that succession began.

The first stage saw a shift in the ecosystem from organisms that thrived on rocky bottoms like midges and caddis flies to soft-bottom dwellers like fingernail clams and burrowing mayflies.

As the pool silted in more, the bottom grew closer to the surface—and to the sun—and aquatic plants began to grow. These plants produced detritus, and as more organic material became available the insect and clam populations grew.

The third stage saw the plants retarding the flow of the water, causing more sedimentation and an even shallower bottom. The stage was set for a transformation from deep-submerged plants to shallower ones with floating leavers and plants that could stand erect. The animal population also changed. A shift occurred from burrowers to climbers and clingers such as dragonfly and damselfly larvae.

Flooding accelerates the process, with each flood depositing another layer of sediment. During this process, the land grows higher and eventually dries out in summer. Plants that grow on soil and can withstand periodic flooding appear, like the black willow.

The river's biological communities form a pattern in space as well as time. Snapshots of these communities taken over the past 70 years and displayed rapidly, like a motion picture, would show open water shrinking and zones of emergent and submergent plants moving from shore toward the channel. Today, zones of marsh near what was the old bank extend to watery areas filled with lotus and give way to the deeper, submerged plants.

All of these zones are still expanding, and the Water and Geological surveys have done some modeling to predict what the pool will look like in the year 2020.

"Essentially we will see a narrow, deep channel with mudflats and islands on either side," explains Sparks. "Much of the lower part of the pool will be dry land for much of the year and flooded in spring. There will be no open water in midsummer. Instead a bottomland forest with willows and soft maples will predominate. Aquatic plants will occur in a narrow zone between the new forest and the channel. The water area will be perhaps one-third of what it is today during midsummer.

There are human implications to succession, too. People who have built boat ramps and homes on the riverfront will be looking at forests in the year 2020. These riverfront residences will be one-fourth of a mile from the water.

Sparks and other researchers believe that long-term ecological research, as long as 30 years in their case, will allow them to make more of these kinds of predictions, so that man can change his environment if needed. In the case of the Keokuk pool, if man wanted to retain open water on the Illinois side of the river, a diversion structure could be built upstream. This kind of structure would provide a steady current source and would prevent sedimentation.

Sparks, who enjoys his membership in the worldwide fraternity of "river men," warns: "Rivers are exciting. People all over the world are realizing that we don't know much about large rivers like this one. Large floodplain rivers, like the Tigris, Euphrates and Nile were the cradles of civilization because the annual flood renewed the fertility of the soil and made it possible to support a concentrated human population in one place for hundreds of years. Man also used the river's aquatic resources: fish and waterfowl for food or sport, rushes for building material and papyrus for paper."

The Illinois LTER project is now in its fourth year of existence. Another 26 years of research will allow Sparks and his fellow researchers to fill in at least some of the gaps in river knowledge.

Dr. Richard Sparks is an Aquatic Biologist who has been with the Illinois Natural History Survey for 13 years. He has been with this project from the time he helped write the proposal to the National Science Foundation. Some of his co-workers and fellow researchers include Ken Lubinski and Bob Gorden of the Natural History Survey; Nani Bhowmik, Rodger Adams and Mike Demissie of the Illinois State Water Survey; David Gross and Richard Cahill of the Illinois State Geological Survey; and Richard Anderson of Western Illinois University.

POSTMORTEM AT WILSONVILLE

The first time Dr. Robert Griffin entered the tiny Illinois town of Wilsonville, every telephone pole had an American flag flying upside down at half-mast and there was a dummy hung in effigy. The head of the Illinois Geological Survey's Geochemistry Section was expecting rocks.

It was 1976, and the angry residents of Wilsonville (pop. 377) were beginning a seven-year fight to rid the town of a hazardous waste landfill located at the edge of town.

In 1978 they won their fight when Circuit Court Judge John Russell ordered the exhumation and removal of all wastes buried there. In 1982 the owner of the site dropped its appeal to the Illinois Supreme Court, and exhumation of the waste began. There are still many scientists who firmly assert that the site was a good one, that the Wilsonville disposal site was just another example of NIMBY - Not In My Back Yard.

The 130-acre landfill operation was a trench-and-fill procedure that mainly relied on natural attenuation of contaminants by a clay-containing till deposit native to the region. The politics of waste management aside, routine monitoring of the site by the Illinois Environmental Protection Agency revealed that organic contaminants were migrating 100 to 1000 times faster than predicted. Scientists and regulatory officials were puzzled by this migration in a site that had long been thought to be one of the best-designed in the state.

The Geological Survey, supported by the U.S. Environmental Protection Agency,and the site owner, SCA Services, Inc., began a study into why the rate of contamination was so high and what this meant for land disposal of similar wastes at other sites.

What the Survey scientists found illustrated the dangers of extrapolating from laboratory tests. There were two reasons why higher-than-predicted migration rates were found. First, there is a substantial difference between laboratory and field permeability values for clay. In the lab, a scientist deals with a very small piece of specimen. What he does not see is the full range of cracks, fissures, animal burrows, root holes and sand lenses present in a site like Wilsonville.

A laboratory measures the matrix of a sample but does not adequately measure the cracks and fractures in a larger block of earth. Water and contaminants tend to exploit these cracks and are thereby transported through the clay matrix.

> Routine monitoring of the site by the Illinois Environmental Protection Agency revealed that organic contaminants were migrating 100 to 1000 times faster than predicted.

Second, organic solvents caused the clay at the site to shrink and crack at the bottom of the trenches. The organic solvents replaced the water in the clay, thus drying out the clay and forming more cracks and fissures for the contaminants to migrate through. This proved more of a problem near the drums, and less at deeper levels where groundwater diluted the solvents.

Regulatory response to the findings of Griffin's team was swift. In-place field tests of soil permeability and hydraulic conductivity for landfills are now required along with laboratory tests. And when laboratory tests are conducted on low-permeable environments like clay, those tests must be discounted by a factor of 100. Just as importantly, the Geological Survey's work provided support for a legislative ban in Illinois on landfilling of liquid hazardous wastes.

The Wilsonville landfill was designed by engineers with only rudimentary attention to the geology of the site. Design criteria for landfills must now include a thorough geological evaluation, sound measurements of the soil's hydraulic conductivity and over-excavation recompaction of fill material.

After a rocky start, Dr. Griffin enjoyed working on the project: "It was gratifying that our work had such a strong regulatory impact. We think we made people aware of the importance of a good geologic site evaluation."

Dr. Robert Griffin is Geochemist and Head of the Geochemistry Section of the Illinois Geological Survey. He has worked at the Survey for twelve years, and has spent his entire career working on containment migration and the effects of pollutants on soil conditions. "Mechanisms of Contaminant Migration Through A Clay Barrier - Case Study, Wilsonville, Illinois" was delivered on April 29, 1985 at the USEPA's Eleventh Annual Research Symposium on Solid and Hazardous Waste. Authors of the article are R.A. Griffin, B.L. Herzog, T.M. Johnson, W.J. Morse, R.E. Hughes, S.F.J. Chou, and L.R. Follmer, all of the Geological Survey.

Surveying ILLINOIS

GEOGRAMS

Coal Research

Four new coal desulfurization contracts have recently been funded through the Center for Research on Sulfur in Coal. The projects will: (1) investigate the removal of both organic and inorganic forms of sulfur from coal by bacteria; (2) perform "ultra-fine" cleaning of coal via explosive shattering and aggregate flotation; (3) investigate the feasibility of improving sulfur dioxide sorption capacity of lime through a physical-chemical process; and (4) study hydrodesulfurization of coal chars.

Mineral Economics

IGS recently prepared a draft report on the impact of a hypothetical Illinois oil severance tax. An average Illinois oil well produces less than three barrels per day, with an estimated economic cutoff production of 1 3/4 barrels. That cutoff production figure is very sensitive to fluctuations in cost increases, well depth increases and oil prices. Preliminary findings indicate that such a tax could lead to increased oil well abandonment.

The U.S. fluorspar industry was analyzed in a recent Illlinois State Geological Survey paper presented at the seventh International Industrial Minerals Congress in Monte Carlo. Declining demand for fluorspar in the United States and low-cost imports have accelerated the shrinking of the U.S. fluorspar industry. Demand in the industry is closely tied to the steel and aluminum industries. Any improvements in the fluorspar industry must be preceded by improved performance in steel and aluminum.

The Superconducting Super Collider

Production of the *Environmental Atlas for Siting the SSC* is underway. The Atlas will demonstrate the depth of knowledge Illinois has available for Superconducting Super collider siting decisions. Forty-five maps and descriptive text will be featured in the categories of natural setting, conservation and preservation, cultural features and wells. The Atlas is a joint production of the three Illinois surveys and the Illinois State Museum.

Satellite Mapping

A colorful "Satellite Image Map of Illinois" has been compiled from 13 images collected from a satellite 450 miles above the earth. Within 10 days after release, the Illinois State Geological Survey received orders for more than 8,000 copies of the map.

Watching the Waste

An inventory of all known waste disposal sites in Illinois is being prepared for the Illinois Hazardous Waste Research and Information Center (HWRIC) by the Geological Survey. The data, compiled from federal, state and county sources, is being entered into a computer file for the HWRIC data base. A computer mapping format has been developed to show the location, method of disposal and type of waste for each disposal site.

Personnel

Dr. Rodney D. Norby, a specialist in Paleozoic micropaleontology has been appointed Curator for the State Geological Survey Paleontological Repository. Norby replaces Dr. Lois S. Kent, long-time Curator who relinquished her duties in the fall.

Dr. Keros Cartwright was appointed to a panel of experts that evaluated and discussed presentations at the International Symposium on Alternative Low-Level Waste Technologies held in Chicago, February 27 to March 1, 1986.

Jim Eidel completed his term as Vice-President of the Society of Economic Geology and has assumed new duties as Chairman of the Program Policy Committee. Recently Eidel also joined the steering group for the Continental Interior Crustal Studies Consortium.

Dr. Charles Collinson represented the surveys in lengthy preparations for recommendations to be presented as a Governor's initiative for Lake Michigan programs.

BIORHYTHMS

Smelt Fishing in Lake Michigan

Rainbow smelt support a lively sport fishery along the Illinois shoreline each spring. On almost any Saturday evening in April, over 1,000 smelt fisherman may crowd Chicago's Montrose Harbor, while another 5,000 use other sites along the shorelines of Lake and Cook counties. During the spawning peak, anglers may catch hundreds of fish each night, averaging over 50 smelt per net per hour. One party of five fishermen this spring landed over 1,000 smelt in approximately two hours on a Sunday night. Estimates made by Illinois Natural History Survey (NHS) researcher William Horns and his assistants indicate that Illinois residents made 70,000 trips to Lake Michigan to fish for smelt, for an estimated total seasonal expenditure of $420,000.

The Crayfishes and Shrimp of Illinois

The first article in the first volume of the *Bulletin* of the Illinois Museum of Natural History, now the Illinois Natural History Survey, was an annotated list of the crustacea of Illinois written by the survey's first Chief, Stephen A. Forbes. It noted the presence in Illinois of nine species of decapods (crayfishes and shrimp). An update to that list, called "The Crayfishes and Shrimps of Illinois," by NHS zoologist L.M. Page, was recently published, raising to 23 the number of decapod species throughout the state. Seventeen of Illinois' 23 species were found in the Shawnee Hills and on the Coastal Plain.

NASA Award

As part of a large team of grassland and forest ecologists. Dr. Louis Iverson and Dr. Paul Risser of the NHS were awarded a grant from the National Aeronautics and Space Administration to explore the use of Thematic Mapper and other spectral patterns in relating local ecosystem findings to estimates of carbon cycling in ecosystems.

The Non-Territorial Squirrel

Information on pine (red) squirrels in Illinois is being developed in a continuing study funded by the Illinois Department of Conservation. The range of the Illinois red squirrel seems to be concentrated along the Kankakee and Iroquois rivers in eastern Illinois. Live-trapping and radio-tracking data from red squirrels living in deciduous habitats shows that these squirrels are not territorial, probably because food supplies in these forests are hard to defend.

Good News on the Des Plaines River

Environmental laws regulating point sources of pollution (e.g. power plant effluents) have reduced contamination of many Illinois rivers and streams. Numerous non-point sources of pollution (e.g. road construction) have disturbed plant and animal habitats, however, and decreased the number of native species found in Illinois' waterways. Baseline data collected by NHS researchers Michael Heneby and Robert Gordon on the Des Plaines River and its natural flood plain in northern Illinois revealed some good news: Both the Des Plaines River and its quarry lakes are relatively unpolluted areas and good examples of fairly "clean" habitats. The problem with restoring species to the Des Plaines rests with stream channelization and excessive siltation. Based on these findings, the Des Plaines River Wetlands Demonstration project will go foward in an attempt to recreate a wet prairie habitat and to increase aquatic and terrestrial habitats.

Wetlands Inventory

NHS is working with the U.S. Fish and Wildlife Service in a project to identify and classify the nation's wetlands on a state-by-state basis. The Illinois component of the National Wetlands Inventory began in 1984. Working with the U.S. Fish and Wildlife Service and the Illinois Department of Conservation, the survey will replace paper-copy wetland maps with quadrangle maps retrievable via the statewide Geographic Information System. The new mapping format will allow better management of these fragile ecosystems.

Water Use Updated

The latest information on water use for 1984 shows that water withdrawals in Illinois totaled 36,831.7 million gallons per day (mgd). Of this total, 1,098.8 mgd came from groundwater resources and 35,732.8 mgd came from surface water resources.

The largest user is electric power generation, 92 percent of the total. Public (mostly municipal) water supply systems in Illinois withdrew 1,797 mgd in 1984, a 3.3 percent increase from 1982.

Irrigation Increases

There has been a substantial increase in the acreage of agricultural lands irrigated, from an estimated 9,000 acres in 1950 to 150,000 acres in 1980 and 208,000 acres in 1984. Total acreage, which includes golf courses, cemeteries, and other grassed areas, under irrigation was estimated to be 245,000 acres in 1984.

Water withdrawals for irrigation during 1984 were estimated to total 200.1 million gallons per day (mdg), compared with 96.8 mgd in 1980. The increase reflects changes in acres irrigated and rainfall.

More Hazy Summer Days

Those hazy, lazy days of summer in Illinois have become more frequent during the past 30 years, Illinois State Water Survey research shows. Visibility, which reflects the most noticeable effects of air pollution, decreased in all parts of the state during summer, but only slightly in spring and fall. During winter there was little change, and winter visibility actually improved at Chicago and Peoria observation stations.

Impact of New Wells

The Water Survey and the Illinois State Geological Survey, in accordance with the Illinois Water Use Act, now conduct studies of the impacts of proposed major new groundwater withdrawals (more than 100,000 gallons on any given day). The surveys also provide technical assistance to state and local agencies as part of the effort to inform the public of major water withdrawals and possible conflicts.

Since requests began in January 1985, the two surveys have made 108 well-site groundwater resource impact evaluations. These concerned 101 wells intended for irrigation use, six wells for public water supplies and one well for industrial/commercial use.

Streamflow Assessments

As the demand for water in Illinois increases, it becomes increasingly important that streamflow conditions, and low-flow conditions in particular, be well managed. This is needed not only to allow for protection of the natural environment of the stream, but also to ensure that enough water is available for users during periods of low flow. Many state policies and tools for water resource planning depend upon evaluation of certain flow values at a given point of interest. The Water Survey has recently developed the Illinois Streamflow Assessment Model to provide the needed standard of information for streams in the state.

Dr. Lin to China

Dr. Shundar Lin, of the Water Survey's Water Quality Section, has received an invitation from the University of Pennsylvania Civil Engineering Department to participate in an 18-day educational exchange program to China being organized under the auspices of the China-U.S. Scientific Exchange. The purpose of this program, which starts July 4, 1986, is to exchange ideas and information on environmental protection.

Huff Gives Horton Lecture

Floyd A. Huff, Principal Scientist Emeritus in the Water Survey's Climate and Meteorology Section, gave the Robert E. Horton Lecture in Hydrology at the American Meteorological Society's conference on hydrometeorology in Indianapolis. The Horton Lecture recognizes an eminent scientist for outstanding research on topics of interest to both hydrologists and meteorologists. Huff spoke on "Urban Hydrometeorology—Problems, Progress and Potential."

Cottontail Rabbits

Illinois has three native leporids. The eastern cottontail, *Sylvilagus floridanus*, occurs throughout the state. The subspecies *Sylvilagus f. alacer* is found in extreme southern Illinois (south of the Shawnee Hills). The subspecies *Sylvilagus f. mearnsil* is found through the remainder of the state. These subspecies are similar in size and general appearance, but a slightly larger and more darkly colored leporid is the swamp rabbit, *Sylvilagus aquaticus*. Its distribution is restricted to bottomland forest, canebrakes, and thickets along the Ohio River and its tributaries in southern Illinois. Illinois' only hare, the white-tailed jackrabbit, *Lepus townsend*, is found today in at most a few scattered, low-density, remnant populations. It may in fact survive only on the Savanna Ordinance Depot in Jo Daviess County.

The cottontail is brown to gray-brown in color with a white underside, a conspicuous cotton-white tail and often a small white spot in the middle of the forehead. Fully mature, they weigh about 3 pounds. Cottontails have earned their reputation for reproduction; however, they do not breed year-round in Illinois. Their annual reproductive cycle is controlled by hormones secreted by the endocrine system centered in the pituitary. That organ responds to changes in length of day—photoperiod. As days grow longer after the winter solstice, cottontails respond physiologically to an increased production of sex hormones and become capable of reproduction. During the truly warm period of late February or early March, they breed. A high degree of synchrony occurs in mating, and essentially all females in local and even regional populations breed in a period of relatively a few hours. The cottontail is said to be a postpartum breeder because females normally copulate only a few minutes after giving birth. Given the synchrony of the initial breeding, a 28-day gestation and postpartum breeding, cottontails show a high degree of synchrony in their reproduction throughout the annual breeding season.

Adult females have four to six litters each breeding season, with an average litter size of about five. Thus an average female in March has the potential to produce 25 to 30 young in the next five to six months. In addition, much of the late summer breeding is probably by juveniles. In a single breeding season, therefore, cottontails have the potential to produce 50 or more young per adult female at the start of the breeding season. Species with high rates of reproduction, however, suffer high rates of mortality, and so it is with cottontails. Typically only one out of six cottontails in early November will survive to the next November.

The peak abundance of upland game, including cottontails, in Illinois probably occurred from 1870 to 1880. Since then the relatively continuous trend to intensively farm has been accompanied by loss of habitat quality and quantity—and by a reduction in the statewide abundance of cottontails. Two conspicuous breaks in this trend have occurred. During the depression of the 1930s, thousands of acres went unfarmed or were withdrawn under subsidy of the U.S. Department of Agriculture and seeded to soil-conserving forage grasses and legumes. These fallow fields and seeded grasslands provided much improved wildlife habitat and cottontail numbers jumped.

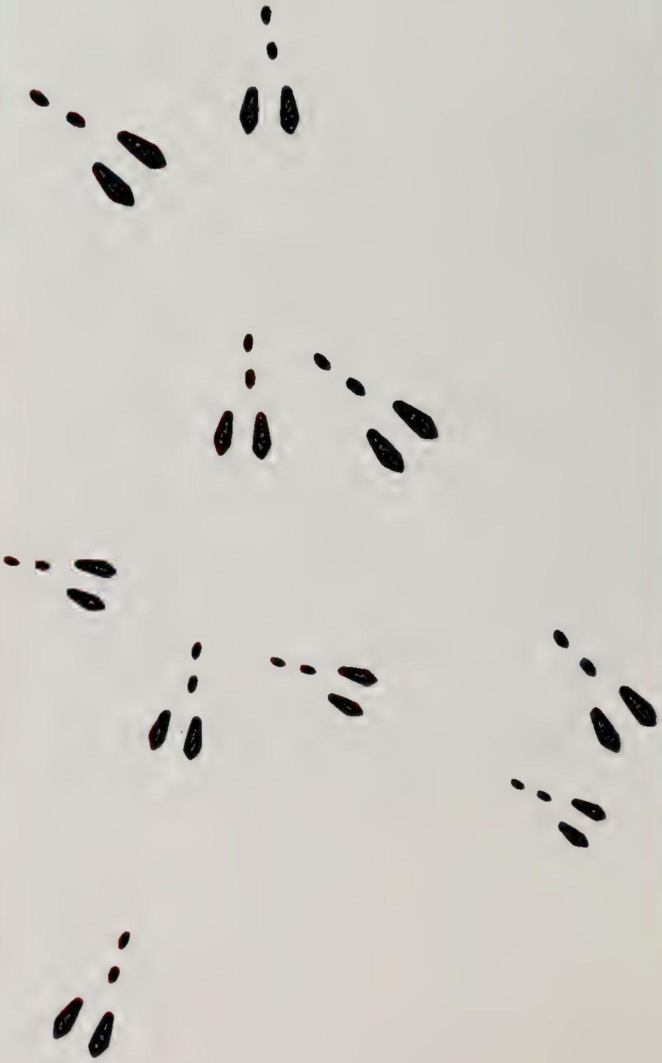
World War II brought strong grain markets and the fields diverted from cropping in the 1930s were again plowed; in the 1940s and early 1950s rabbit numbers once again fell. By the mid-1950s American farms were again overproducing and grain prices fell. The Soil Bank was established in 1956 in an attempt to restore agricultural markets and to conserve soil by seeding diverted acres to grasses and legumes. Once more cottontails benefited. As the Soil Bank began to be phased out in the early 1960s, cottontail numbers began a decline that has continued more or less unabated. Since about 1960 the number of cottontails has declined more than 70 percent statewide and more than 90 percent in intensively farmed regions. The phasing-out of the grassland-type seedings made under federal subsidy was particularly significant.

Perhaps even more important was the continuing loss of unimproved pastures that often provided an ideal combination of weeds, briars and brush for cottontail cover. In the long run cottontail populations clearly reflect changes in land use and habitat; however, even where habitat is relatively stable, large fluctuations in numbers from year to year are apparent on individual farms locally and even regionally. Cottontail numbers are also affected by adverse weather (especially subnormal temperatures accompanied by above normal precipitation), predation and diseases such as tularemia. Where rabbits are found in relative abundance, however, they remain a sought-after game species in Illinois.

Cottontails tend to clump together on "islands" of favorable habitat. They apparently evolved the capacity to survive in a variety of woodland edge and disturbed environments that developed locally as a result of such random events as fires, floods, outbreaks of plant diseases and grazing. These islands of cover were somewhat separated in space and temporary in time (successional) because they reflected natural types of habitat disturbance. Dispersal is critical for the perpetuation of animals like the cottontail that are dependent on successional habitats. Although dispersing individuals typically suffer high rates of mortality, sufficient benefit accrues to those who are successful in establishing home ranges in new locations for dispersal to have survival value for the species.

Wildlife managers often refer to a "harvestable surplus" of annually produced animals that provides the basis of sport hunting. Under normal conditions wild populations produce considerably more young than are needed to compensate for the natural mortality of purely resident individuals. As a rough approximation about half of the annual number of young that survive until the hunting season may be taken by hunters without jeopardizing the local breeding population or the number of dispersers needed for recolonization. If we return to the idea of cottontail habitat as islands in a sea of intensive agriculture, dispersal comes into clearer focus. In effect, as agricultural land use intensifies, habitat islands become fewer, smaller and farther apart. These islands sustain fewer residents and put out fewer dispersers; these dispersers in turn have less chance of reaching another island. Populations on smaller islands have a greater chance of becoming extirpated (going to zero), with longer average time intervals to recolonization at lower rates of recolonization. On average the result is a combination of less habitat supporting lower densities of animals per unit of a habitat.

Dr. William R. Edwards is an Upland Wildlife Ecologist with the Wildlife Research Section of the Illinois Natural History Survey. He specializes in research on upland wildlife ecology and has been with the survey for 23 years.



URBAN DEER

The forest preserve district in Cook County is unique with about 100 square miles—66,747 acres—of open land in the heart of one of the most heavily populated regions in the country. But the forest preserves are coming under attack from what most city dwellers would consider an unusual foe, the urban white-tailed deer.

Dr. Jim Witham of the Illinois Natural History Survey is Project Leader for a six-year study investigating deer ecology and deer-related problems in urban areas of Cook, DuPage, Kane and Lake counties. The project, jointly sponsored by the U.S. Fish and Wildlife Service and the Illinois Department of Conservation (DOC), began in July 1983, and has just received a three-year extension.

A large deer population has developed in the forest preserves, nearby parks and other suitable habitats. Some herds have increased dramatically during the past decade, altering forest vegetation and reducing the quality of habitat for the deer themselves. Areas with more than 100 deer per square mile have experienced a severe impact on vegetation. An aerial survey conducted in the winter of 1984-1985 found a minimum count of 1,800 deer in the Cook County forest preserves. Many deer remain undetected during aerial surveys, and it is extremely difficult to estimate the percentage of the total herd that is observed. In reality, the number of deer in Cook County is probably much greater than 1,800 animals.

Jim Witham explains the effects of large numbers of deer in limited habitat: "In several preserves there has been substantial damage to forest vegetation, both in the herbaceous and shrub layers. The deer have established a browse line in the forest about 1 to 1 1/2 meters high. Heavy foraging pressure by the deer is changing the composition of the forest vegetation, reducing the number of plant species and altering the vertical structure of the forests."

"Numerous complaints have been received from area residents about deer eating valuable ornamental shrubs, and there has been damage at the Morton Arboretum and the Chicago Botanical Gardens. Many homeowners used to put out corn for the deer to draw them into their backyards. Now they're writing into DOC for literature on deer repellents."

"Finally, there are the deer transportation problems. Deer inhabit woodlots adjacent to the runways at O'Hare Airport and have been removed from the airport on occasion. Beyond that, deer-vehicle collisions on Cook County highways have substantially increased during the past decade. In the past four years deer-auto accidents in northwestern Cook County have doubled each year. We finished our deer carcass collection program last October and examined 1,000 carcasses—most resulting from deer-vehicle collisions."

Urban deer are a problem in other cities like Milwaukee, Minneapolis, Cleveland and Detroit and along the East Coast. But no area compares with the Chicago metropolitan area in terms of size and distribution of forests, the large number of deer and the human population affected.

Before DOC can do anything about the deer population, it needs solid information. The Natural History Survey's goal is to give DOC that factual base. The objectives of the study are to determine how many deer are in the urban area, where they are, how fast their numbers are increasing, what their behavior and habitats are, whether they are healthy, how much damage they are causing, how many need to be removed for effective control and relative costs of several possible methods of control.

The two areas sustaining the greatest damage are the Ned Brown Preserve near Elk Grove Village and Schaumburg and the Des Plaines River near Wheeling. The deer in the Ned Brown Preserve show the classic signs of over population: smaller antlers and body weight, less fat reserves for winter, chronic seasonal malnutrition, high subadult mortality rates and low reproductive performance.

> "Many homeowners used to put out corn for the deer to draw them into their backyards. Now they're writing into DOC for literature on deer repellents."

The study has also allowed the survey to perform some much-needed research on the nutritional profile of the deer herds in northern Illinois. The bulk of Jim Witham's time is spent picking up road-killed deer and performing autopsies in conjunction with Dr. Bruce Watkins, a Brookfield Zoo nutritionist. The whole body composition study conducted with Dr. Watkins augments the researchers' general nutritional assessments of herds in northeastern Illinois. Data from this segment of the study will be used to evaluate how accurately condition indices (physical measurements, weights, fat deposition, blood parameters and others) used in the general nutritional assessments predict true body composition. Tissues have also been sampled and tested for levels of polychlorinated biphenyl (PCBs), pesticides and heavy metals. All of this will give Witham and fellow researchers the data to build a complete profile on urban deer herds.

The population study on the deer will phase into a management study. That study will evaluate methods of controlling the deer population. Options include no direct intervention and then projection of the consequences for both deer and vegetation, the use of live traps and transportation to other sites, direct reduction of selected herds through professional shooters or public hunters and chemosterilization.

According to Witham, every option has a host of associated problems: "A single method of control will not be effective under all circumstances. We need to make individual assessments of each area and situation. It is clear that white-tailed deer will remain an important component of the urban environment in northeastern Illinois."

Dr. Jim Witham, Project Leader of the Urban Deer Study, has been with the Illinois Natural History Survey since September 1983. He is currently headquartered on land owned by the Cook County Forest Preserve. The Project Field Supervisor is Jon M. Jones, also with the Natural History Survey. Dr. Glen C. Sandersen, head of the survey's Wildlife Research Section, is the Principal Investigator of the project.

ILLINOIS RESEARCHES HAZARDOUS WASTE

A 1981 U.S. Environmental Protection Agency survey of hazardous waste generators indicated that 264 million metric tons of hazardous waste are generated each year in the United States. The implications of this figure are staggering for a highly industrialized state like Illinois. Every state generates hazardous waste, but about 60 percent of the total is generated in 10 states. New Jersey is the number one generator, followed by Illinois and Ohio. Between 3 and 10 million tons of hazardous waste are generated in Illinois each year, about 7 percent of the nation's total.

These numbers have not gone unnoticed by the media or the general public. Names like Times Beach, Wilsonville and Sheffield are indelibly imprinted on Illinoisans' memories. More sites like these come to the public's attention every week. The U.S. Environmental Protection Agency is projecting that federal cleanups under the Superfund program at 1,400-2,200 sites will cost between $8.4 billion and $23 billion. Two versions of a Superfund extension bill now under congressional consideration would increase monies available for Superfund projects from $1.6 billion for 1980-1985 to $7.5 billion-$10 billion for 1986-1990. State hazardous waste program managers, even less optimistic, estimate that more than 7,000 uncontrolled hazardous waste sites will require some form of cleanup action.

Regulation and Research

New federal laws have established unprecedented corporate liability for the cleanup of hazardous wastes. Many states have established comparable—and in some cases stricter—requirements. As a result, federal and state regulatory agencies are now armed with broad legal authority to complete cleanups and the resources to do it themselves if industry refuses. Two federal laws are causing high levels of anxiety in America's corporate boardrooms.

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HAZARDOUS WASTE RESEARCH
AND INFORMATION CENTER

The first of these is the Comprehensive Environmental Response, Compensation and Liability Act, better known as Superfund, which applies mainly to abandoned hazardous waste sites. Liability under this law attaches without regard to fault or negligence and is subject to only a few narrowly drawn defenses. The second act is the Resource Conservation and Recovery Act (RCRA), which regulates the handling of hazardous wastes at currently operating or future facilities. More and more businesses are coming under the regulatory aegis of RCRA, many of them small businesses.

Much of the hazardous waste in Illinois was generated prior to the establishment of any regulations governing waste management. The dangers and liabilities resulting from improper waste handling were barely recognized when these wastes were disposed of. Even now there are still critical "unknowns" which must be addressed before the handling of hazardous wastes becomes a science.

The Illinois Chemical Safety Research Initiative

Illinois has responded to these developments with its own legislative program. That program included legislation that:

- encourages recycling rather than landfilling
- prohibits the landfilling of liquid hazardous waste beginning in 1985
- requires industry to reveal to workers their exposure to chemicals in the workplace
- allows local governments a voice in the process of locating hazardous waste landfills

> "We walk a fine line. We're not consultants and we're not a regulatory agency. We give industry, particularly small businesses, a first line of advice on how to handle these wastes."

Legislative changes in the way Illinois regulated hazardous wastes were accompanied by the recognition that answers needed to be found to the critical unknowns of hazardous wastes: what wastes are most liable to be released into the environment, what are their characteristics, what are the best management methods for disposal of these wastes and how can reduction of hazardous wastes be accomplished?

In July 1984, Governor James R. Thompson launched the Illinois Chemical Safety Research Initiative to find answers to these unknowns. The program had three major components:

- Development of toxicity testing protocols by the Illinois Environmental Protection Agency to evaluate the health and environmental effects of chemical substances in wastes and effluents
- Data-gathering on chemicals and health effects by the Illinois Department of Public Health's Health and Hazardous Substances Registry
- Establishment of a Hazardous Waste Research and Information Center in the Illinois State Water Survey

The Hazardous Waste Research and Information Center

The Hazardous Waste Research and Information Center is an interdivisional program of the Illinois Department of Energy and Natural Resources, hosted by the Illinois State Water Survey. It is designed to be the focus of a comprehensive research and information program on hazardous waste issues. Its three major programs are:

- *Research* to determine the extent and magnitude of Illinois' hazardous waste problems and to work toward solutions for those problems
- *Information Resources*, gathered, analyzed and disseminated to improve the understanding of the complexities, costs, risks and potential benefits of proper hazardous waste management
- *Assistance* provided directly to industry to encourage the adoption of alternative technologies for treating hazardous wastes

David Thomas, Director of the center, summarizes its mission: "We walk a fine line. We're not consultants and we're not a regulatory agency. We give industry, particularly small businesses, a first line of advice on how to handle these wastes. Eventually we'll add to that the services of a hazardous waste laboratory, with chemical analyses of samples available and research and pilot studies on alternative treatment technologies."

Categorizing Special Waste

In the center's first year of operation nine research projects were begun. The Special Waste Categorization Study was mandated by the Illinois Legislature. Special wastes included those wastes covered by the federal RCRA, all industrial process waste and pollution control waste. The study developed a system for categorizing wastes according to the threat posed to human health and the environment—the "degree of hazard." Wastes that ranked low or posed a negligible threat could be subject to less stringent regulations in the future.

> When the study began, it was assumed that even the oldest disposal sites (50-100 years old) might still pose a threat to groundwater. The results so far indicate that the threat is not as great as originally believed.

Because this study generated so much interest, additional monies were appropriated to continue the categorization of special wastes. The methodology for determining the degree of hazard will be refined and applied to categorize up to 200 individual waste streams. Recommendations will then be made for the deregulation of those non-RCRA wastes that do not pose a hazard to human health or the environment.

Looking at Old Waste Sites

Ten research projects are currently underway at the center. Some of these continue to address the nature of the hazardous waste problem. Others focus on finding solutions to specific identified problems.

One such project is identifying areas of possible groundwater contamination due to improper disposal of industrial wastes over 100 years ago. An historical geography of waste disposal in Winnebago County in northern Illinois is being conducted in conjunction with an analysis of geology and groundwater flow patterns. Two conditions make Winnebago County ideal for this type of study. It has a century-long history of intense industrial activity and over 50 percent of its drinking water is drawn from shallow and gravel aquifers. These aquifers are very susceptible to contamination.

Using a computerized mapping system called the Geographic Information System, historical maps of industrial activity will be generated and combined with contemporary maps of the county's water wells and groundwater flow patterns. These maps will be overlaid to indicate the location of potential groundwater contamination from industrial wastes.

Research so far has led to some tentative conclusions. When the study began, it was assumed that even the oldest disposal sites (50-100 years old) might still pose a threat to groundwater. The results so far indicate that the threat is not as great as originally believed. Sand and gravel aquifers drain quickly and the contaminants move rapidly through them. Although hundreds of disposal sites have been discovered, the current study focuses on those that contain hazardous wastes and are located near sand and gravel aquifers.

Future Challenges

From a scientific standpoint, Thomas finds cross-media pollution one of the most interesting in dealing with hazardous wastes.

"Suppose you destroy dioxin in an incinerator, a method that's highly touted nowadays. Most measurements are being taken at the stack, in fear of dioxin escaping there. But the problem might not be the output of principal organic compounds (POC's). The problem may be in the process itself. That process might generate by-products known as PICs, products of incomplete combustion that you aren't even looking for," Thomas said.

Thomas' vision of the Hazardous Waste Research and Information Center is one of a multi-service organization offering a number of services to a large and diverse client base.

"A balanced natural resource and waste management strategy in Illinois requires timely expert advice based upon the best available engineering and scientific analyses. The center will fill that role," he said.

Dr. David Thomas joined the Illinois State Water Survey as the Director of the Hazardous Waste Research and Information Center in May 1985. He received his bachelor's and master's degrees in ecology from the University of Illinois and his doctorate ecology from Cornell University. Most recently he worked for a private consulting firm performing environmental studies.

INADVERTENT WEATHER MODIFICATION

Introduction

For the last three millennia mankind has struggled with the vagaries of nature. Among those elements most seriously affecting our survival and efforts to improve our lives is the climate. Beginning with the Romans there have been various beliefs and practices for purposefully influencing the weather including prayers, incantations, offerings and cannonades. However, it has only been in the recent 35 years, in what might be labeled the modern age of meteorology, that serious scientific attention has been given to two weather change issues: how man might purposefully alter the weather to protect or enhance his world and secondly how man is accidentally altering the weather. This article will focus on the second phenomenon, also known as "inadvertent weather modification."

Inadvertent weather modification is defined as the study of those atmospheric processes altered only during certain conditions and over limited geographic scales. In contrast climate modification is seen to come from a persistent bias imposed upon the atmosphere that acts on hemispheric scales.

History

The field of inadvertent weather modification followed a very different track than planned weather modification, but it too has had scientific controversies. In the United States some of the earlier definitive work on inadvertent weather modification occurred in the 1950s and early 1960s. Helmut Landsberg and others brought their interests and research to the United States from Europe, where urban-related weather modification studies had occurred for decades.

A conference held in Cincinnati in 1960 brought together for the first time a series of scientists who were beginning serious studies of inadvertent weather modification. The concept of atmospheric modification as a result of man's land use changes was gaining awareness and attention. The announcement of the LaPorte Anomaly in the mid 1960s brought forth considerable interest and debate about whether urban areas altered precipitation well beyond a city.

Public concern and scientific awareness of inadvertent weather modification grew rapidly from 1967 to 1975. Urban-induced modification of many weather conditions had been recognized for many years and the clouds and fogs induced by large power plants were obvious. All facets of the weather and climate, including the temperature, humidity, clouds, precipitation, wind, visibility and air composition are changed by large cities.

Urban induced modification of many weather conditions had been recognized for many years, and the clouds and fogs induced by large power plants were obvious.

Attention to inadvertent weather modification became quite high during the 1970s. The Metropolitan Meteorological Experiment (METROMEX), the first major effort to intensively study urban effects on weather, occurred during 1971-1976 at St. Louis. Other climatic and field studies addressing power plants, irrigation effects, contrail effects and industrial complexes were pursued.

Inadvertent weather modification is assessed herein on the bases of scale of the conversion force or factors influencing the atmosphere, not on the processes. Inadvertent weather changes are primarily caused by changes in the radiative and heat budgets of the atmosphere. However, particulates and changes in the moisture budget are also involved.

Non-Urban Production Centers

One set of studies focused on "non-urban production centers," generally isolated power plants and industrial centers where concentrated releases of heat, energy and pollutants exist. For example the magnitudes of latent heat (in the form of water vapor) released from cooling towers in a single large (2200 megawatts) power plant in Illinois is one-seventh of that released by the entire St. Louis metropolitan area. Studies have shown that coal-fired power plants, petrochemical industries and wood processing plants are prolific sources of cloud condensation nuclei (CCN), leading to observed increases in fogs and clouds and in some instances snow and rainfall. The weather changes produced by such isolated centers are reasonably well-explained and predictable, at least for the major climatic zones of the United States.

Urban Weather Changes

Attention to weather change from urban areas has exceeded that given to any other land use. Several definitive climatic studies for a variety of cities in the United States were done during the 1960s and 1970s. The METROMEX field experiment at St. Louis focused on all summer conditions, primarily in an effort to dimensionalize the urban factors affecting clouds, precipitation and storminess. The urban influences on the precipitation conditions are the primary urban-induced changes that extend well beyond the city.

Subsequent studies have been pursued in the Chicago area. Studies of summer precipitation at Chicago largely substantiated the findings at St. Louis; that is, rainfall was increased about 15 percent on the average over portions of Chicago and in an area east of the city. This increase was realized most often in the more unstable convective conditions typically with squall lines, another finding common to St. Louis. In many respects knowledge of how urban areas influence weather conditions is more advanced than that with any other type of land use change.

Agriculture

Agricultural lands and related activities also affect the weather. The slash and burn approach to elimination of crop and weed residues in certain areas provides aerosols that can effect radiation and visibility, and some are effective as CCN and thus effect clouds and rainfall production. Another agricultural activity that has been partially studied, but only from a climatic point of view, are the weather influences of large-scale irrigation. Climatic studies of sizable areas of irrigation in the state of Washington and in other sub-humid regions from Nebraska to Texas suggest summer rainfall increases of 15 percent or more.

Transportation Corridors

Another area of study of inadvertent weather modification relates to "transportation corridors." The potential effects of contrails and their influence on cloudiness and in turn on temperature have been studied. In the major east-west flight corridor across the Midwest, there has been an anomalous increase of 20 percent in high cloudiness in the last 20 years. Available evidence strongly suggests it is largely the result of jet contrails. Major surface transportation corridors also affect the atmosphere by direct heat emissions from vehicles by moisture emissions and by pollutants from vehicles. These have been demonstrated to lead to local temperature changes and to a production or intensification of fogs. Such corridors also add to regional concentrations of particulates that diminish visibility.

More Research Needed

There are still many areas of uncertainty with respect to inadvertent weather modification deserving of further research. First, urban influences on winter precipitation have yet to be examined in depth. It is recognized that urban areas affect winter precipitation, but how the effect occurs and to what extent is yet to be well-defined.

Another area of considerable uncertainty relates to influences from sizable nonagricultural areas; that is, what really happens after major deforestation, drainage of swamps or the changing of grasslands? The current concern over weather effects in Florida due to draining of interior lands is an illustration of just one such research opportunity.

Physical-type studies are needed to define how large-scale irrigation affects the weather. Climatic studies have indicated that the area of irrigation in the Great Plains has produced summer rainfall changes, but how?

In general the ability of man through megalopolises, jet aircraft, irrigation and the production of haze to alter regional weather conditions seems to be a principal area of research. Some of the more simple and easy research has largely been accomplished and what remains will be more difficult, often requiring in-depth climate studies, modeling and extensive field studies.

There is great need for further studies of the impacts, whether they are social or environmental, relating to known inadvertent weather and climate changes. The major issue facing both the National Climate Program and the weather modification interests is the question, "What happens when the weather or the climate changes?"

This article is excerpted from a paper presented at the 1983 Annual Meeting of the Association of American Geographers, Denver, at the invitation of the Climatology Special Interest Group.

Stanley Changnon retired as Chief of the Illinois State Water Survey in August 1985. Changnon has been with the survey since he graduated from the University of Illinois in 1951. Under his leadership, the Water Survey grew to 230 staff members, with research and service programs in atmospheric and water chemistry, water quality, surface and groundwater hydrology, and climatology and meteorology. After his retirement, Changnon returned to the survey as a Principal Scientist. He is also a Professor of Geography at the University of Illinois.

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of Illinois

About the Cover

The cover depicts the scenic Mississippi River at Mississippi Palisades State Park. Our story on understanding the nature of rivers appears on page 4. Photo by Tom Hecht.

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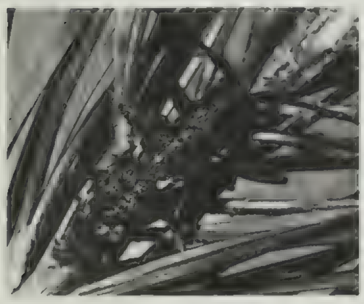
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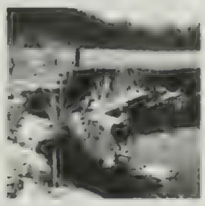
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About the Cover

Lake Michigan's waves encroaching on the base of an apartment building in the Rogers Park area of Chicago.

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Editorial Staff

Jane A. Bolin
Linda Classen Anderson
Editors

ComUnigraph
Design and Production

Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 2021 Illini Road, Springfield, IL 62704.

The Society encourages readers to submit letters to the editor of The Nature of Illinois at the address above

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The Society Page

The Society for the Illinois Scientific Surveys is proud to present its second issue of The Nature of Illinois, a magazine dedicated to informing the public about the important research conducted by the Illinois Scientific Surveys - The Geological, Natural History and Water Surveys.

Following our first issue, we received many requests for more information about the Society, which I will share with you here.

The Society is a not-for-profit organization with tax-exempt status. Its purpose is to enhance the wise use and management of the natural resources of Illinois through support of the activities and programs of the Surveys, thereby enhancing the economic development of the State and improving the quality of life in Illinois. The Society is needed to help build a constituency for the Surveys, and to provide a program through which citizens of Illinois can better understand the natural resources of the state.

Membership in the Society is open to any person or group that subscribes to the purposes of the Society and that, after applying with the appropriate payment of fees, is accepted. The types of membership available are listed.

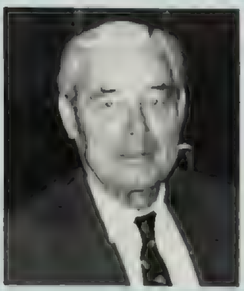
Initially, the Society hopes to educate the public through its magazine, programs for students and science teachers, public television programs and more.

It is a worthwhile endeavor, and I hope you or your organization will consider joining us.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors



The Society for the Illinois Scientific Surveys

Scale of Contributions

Personal Memberships

Individual	$25 per year
Family	50 per year
Contributing	100 per year
Founding	1,000 per year

Corporate/Business Memberships

Patron	$250 per year
Sponsor	500 per year
Associate	1,000 per year
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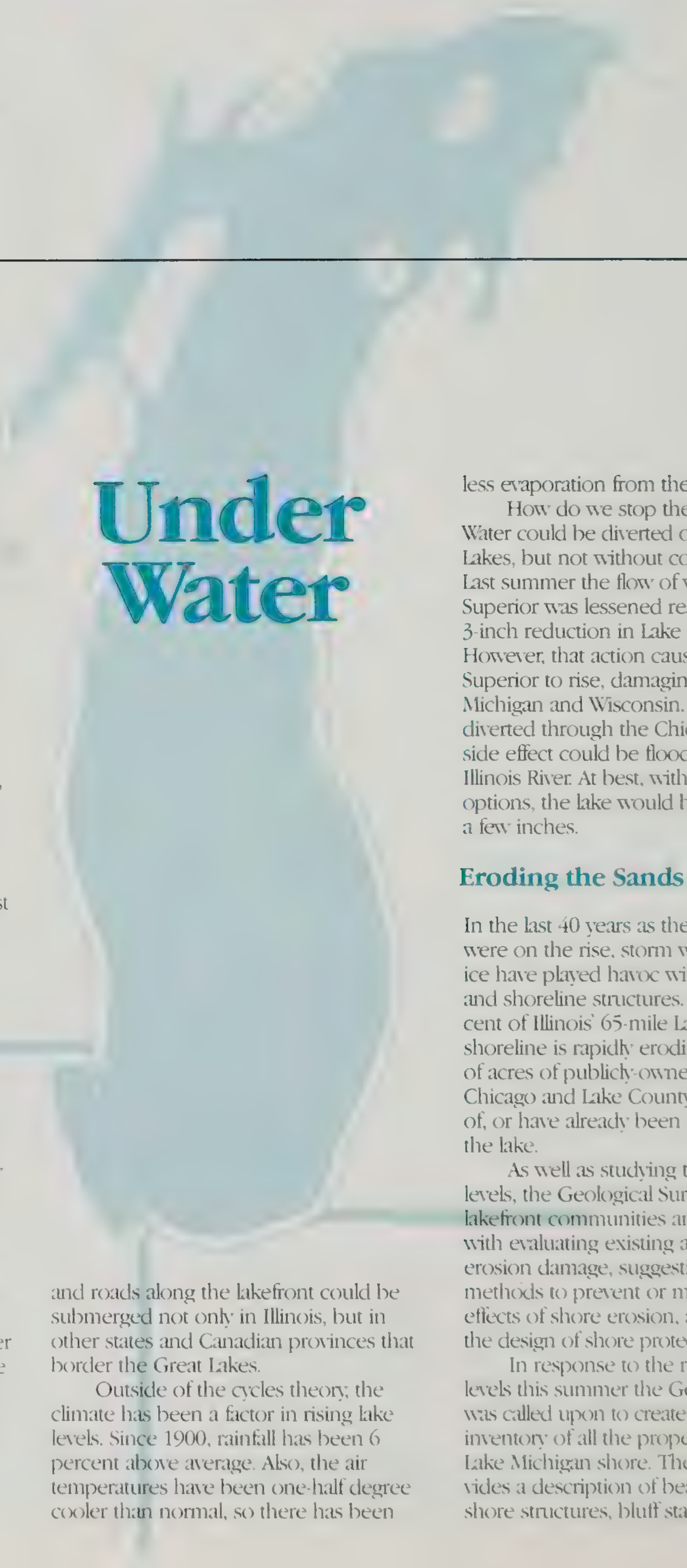


Under Water

Illinois residents with lakefront property on Lake Michigan are getting a better view and closer access to the water than they anticipated.

Lake Michigan, as well as the whole Great Lakes system, is at its highest recorded level since the U.S. Army Corps of Engineers began taking records in 1860. In June, the lake was at 581.08 feet IGLD, surpassing the previous record high set in July of 1974. It broke the record in July, August and September, and having climbed past 582 feet IGLD, now stands at 581.7 ft.

"What was once thought to be abnormally high levels, may in fact be the normal level for the lake," said Dr. Charles Collinson, Principal Geologist at the Illinois Geological Survey. The Survey has been involved in shoreline erosion studies for the past 15 years.

Previously, researchers believed that the Great Lakes' water levels fluctuated in regular 22-year cycles. This was based on information recorded during the last 126 years. However, if the 22-year cycle theory is true, the lake levels should now be falling instead of rising.

Recent evidence gathered in a study funded by the Geological Survey suggests that the 126-year period of record-keeping represents only a small portion of a longer, historical cycle for the lake. It suggests that every 500 years over the last 2,000 years, Lake Michigan rose to about 585 feet - or nearly 3.5 feet higher than its current levels - and stayed there for decades.

If this theory is true, Collinson said, much of Illinois' shoreline development took place during abnormally low lake levels. Scientists fear that beaches, residential and commercial buildings, and roads along the lakefront could be submerged not only in Illinois, but in other states and Canadian provinces that border the Great Lakes.

Outside of the cycles theory, the climate has been a factor in rising lake levels. Since 1900, rainfall has been 6 percent above average. Also, the air temperatures have been one-half degree cooler than normal, so there has been less evaporation from the Lakes.

How do we stop the rising tide? Water could be diverted out of the Great Lakes, but not without consequences. Last summer the flow of water from Lake Superior was lessened resulting in a 3-inch reduction in Lake Michigan. However, that action caused Lake Superior to rise, damaging property in Michigan and Wisconsin. If water is diverted through the Chicago River, the side effect could be flooding down the Illinois River. At best, with either of these options, the lake would be lowered only a few inches.

Eroding the Sands of Time

In the last 40 years as the Great Lakes were on the rise, storm waves and shore ice have played havoc with near-shore and shoreline structures. About 20 percent of Illinois' 65-mile Lake Michigan shoreline is rapidly eroding. Hundreds of acres of publicly-owned land in Chicago and Lake County are in danger of, or have already been flooded by the lake.

As well as studying the rising lake levels, the Geological Survey assists lakefront communities and landowners with evaluating existing and potential erosion damage, suggesting various methods to prevent or mitigate the effects of shore erosion, and aiding in the design of shore protection structures.

In response to the record high lake levels this summer the Geological Survey was called upon to create a computerized inventory of all the properties along the Lake Michigan shore. The inventory provides a description of beach conditions, shore structures, bluff stability and the history of the site.

"This type of information is important for use in identifying changes taking place in shoreline properties and structures, for evaluating properties and making recommendations on what should be done to help prevent further damage," said Nancy Holm, Limnologist for the Lake Michigan Program at the Geological Survey. "Having the information computerized gives us easy access to it as we get many calls from property owners, engineers and state officials interested in this information."

Out of the 65-miles of shoreline included in the inventory, approximately 40 percent is public and private beaches. The inventory reveals that they are rapidly disappearing. In Chicago, all beaches are manmade and many south of McCormick Place are essentially gone, said Holm. Beaches north of Hollywood Beach are partially submerged, if not completely. Oak Street Beach is half as large as it was three to four years ago. Glencoe Beach is one-third smaller. In 1964, Highland Park beaches lined 95 percent of the shore; now 70 percent of the shoreline consists of concrete sea walls, piles of rock and other shore erosion prevention structures.

At Illinois Beach State Park where the Geological Survey has done extensive work for the Department of Conservation, thousands of feet of beach have been lost in the past ten years, said Holm.

For an individual who resides on the lake, cars frozen in ice, ice chunks shattering windows, and water seeping under doors are constant reminders of the problem.

One of the areas hit hardest is a section of Chicago along North Sheridan Road, which has the highest population density on the Great Lakes. Residents are working to establish some type of construction in the lake to break the wave force. With urging from a task force consisting of city, state and federal officials, and residents, Governor James R. Thompson requested federal assistance from the U.S. Army Corps of Engineers through the Advanced Measures Authorization. The Corps has used much of the data collected by the Geological Survey in its shoreline study to determine if there is a cost-effective solution to the flooding and water damage.

Lake Michigan waves washing over the end of the street at West Granville in Chicago

As well as the shoreline inventory, the Geological Survey has recommended establishing an Office of Lake Michigan, which would be the main coordinator of programs and policies for shorelines Holm said. Other recommendations included community planning for shore line structures since erosion protection in one area can have a detrimental effect on other properties down the shore; and that structures such as breakwaters and groins be built two feet above present guidelines.

"What was once thought to be abnormally high levels, may in fact be the normal level for the lake."

"We have proposed a project to study the environmental impact of elevated lake levels," Holm said. "It was not funded for this year, but we would hope to get support for it in the future. We would be studying the geological aspects of increased sedimentation - the littoral drift patterns, shore instability, beach destruction, and more. I don't know of anyone studying the effects of the high lake levels and increased sedimentation on plant or aquatic life in the nearshore of Illinois now. Our study would help to provide some detailed geological information for these other studies."

A project involving all three Scientific Surveys that would encompass atmospheric studies, geological, biological and water chemistry (pollutants, etc.) on Lake Michigan is also being planned.

Lake Michigan's waves pound Chicago's shoreline this summer as the lake reaches its highest levels ever.

The City of Lake Forest is in the process of building an offshore breakwater to lessen the erosion along its shoreline. This is controversial since it may have adverse effects on property down the shore

"The more we know about the lake, the more prepared we will be in the future for dealing with fluctuating water levels and the consequences," Collinson said. "It's important to develop a long-term approach to co-existing with the lake, not just quick fixes, which will not last in the long run."

Dr. Charles Collinson, Principal Geologist at the Illinois Geological Survey, is in charge of the Lake Michigan program Nancy Holm, Limnologist, is also involved with the program

Building a Better Scarecrow

Reports of collisions and near-misses between large and small aircraft have become a staple in the daily news. Of lesser notoriety, but also costly and dangerous, are collisions between aircraft and their smaller brethren — birds. Accurate statistics on these collisions are hard to come by, but reliable evidence suggests they cost tens of millions of dollars annually.

Hazards caused by birds are divided into two categories: collisions that occur on or near the ground and collisions that occur enroute. About half of these impacts occur near the ground. Civilian and military aircraft are equally affected. Civilian aircraft are in greater danger near airports, while low-level, high-speed military exercises are subject to continuous collision hazard whenever birds are flying.

Drs. Ronald Larkin and Douglas Quine of the Illinois Natural History Survey are experts on the theory and practice of scaring birds away from airports and aircraft. As the U.S. Air Force and federal agencies develop a radar weather warning system called NEXRAD, the Survey researchers are working to piggyback a real-time bird warning system onto NEXRAD.

The Biological Underpinnings

To frighten birds away from airports and airplanes, the basic biological mechanisms of birds must first be understood. Dr. Larkin describes a bird's reactive system: "In deciding whether or not a particular object or stimulus represents a danger, it is probably best for a small animal to be conservative and react immediately to any possible danger. Flight or protective response may be elicited by a wide range of stimuli: moving objects, strange stimuli or situations, and stimuli which are sudden in nature or high intensity."

Given the propensity of birds to flee such a large range of stimuli, it would seem an easy task to frighten them away from aircraft and airports. Unfortunately, an animal's fleeing response wanes after a number of presentations. This process is called habituation: the bird becomes accustomed to the stimulus and ignores it.

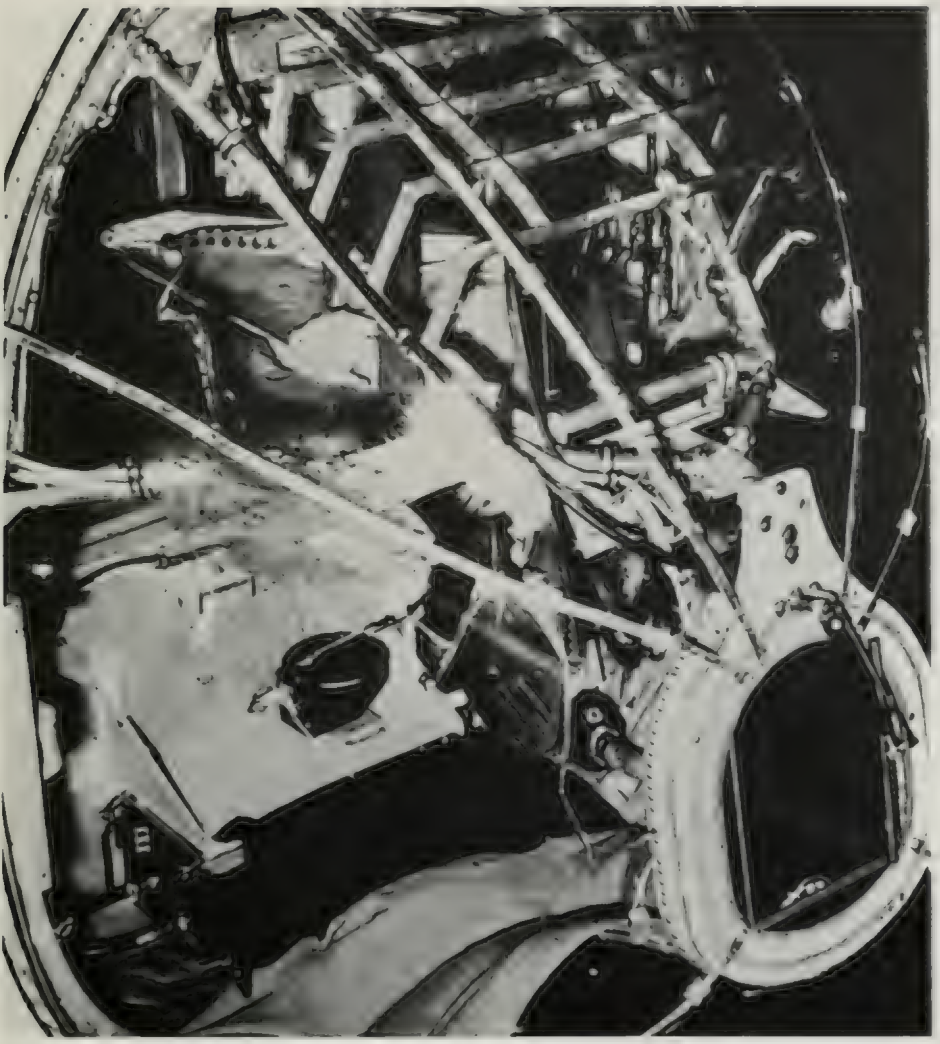
Municipalities have tried to site dumps near airports, hoping to group garbage nuisance and noise nuisance together. Unfortunately, this means birds have a stronger motivation to stay near the airport.

The habituation response has proved the undoing of many promising attempts to scare birds away from airfields. One such system involved lines of loudspeakers arranged along runways, with tapes of distress calls played by operators in the control towers. The system worked for five months, after which the birds habituated to the calls and "with the speakers working, congregations of birds would gather around individual speakers in the manner of audiences at an open air theater, listening to the anguished cries of some long lost acquaintance suffering in the cause of science." Finally the birds lost all interest in the show and ignored the playbacks completely.

"Three points should be kept in mind by airport managers in keeping birds at bay," says Larkin. "The scaring stimulus should have so definite a biological meaning to the birds that reactions persist without habituation or they abandon the airfield altogether. Second, stimuli can acquire biological meaning as birds learn danger from other birds. And third, birds are alert, sensitive, quick creatures that are much more at home in the air than the most experienced pilots. They have color vision and hearing that is comparable to man's."

Scaring Techniques

Using this basic information about bird biology has resulted in a variety of bird-scaring techniques. No one solution has



Bird-aircraft collisions cost tens of millions of dollars annually.

proved effective because of the problem of habituation and the differing responses of bird species to the same stimuli.

What doesn't work: intensive microwave radiation sources — possibly hazardous to humans, and starlings like to nest in the antennas of large radar sets; sounds at ultrasonic frequencies; shooting campaigns with shotguns - birds quickly learn to stay just out of range.

What does work: arm-flapping by airport personnel — cheap and effective, but hard on the morale and the arms of the workers; dead birds and models of dead birds; using actual predators, such as dogs, falcons and accipiters; exploding devices including acetyline cannons, loud pistols and the Shellcracker, a 12-ga. shotgun shell designed to explode with a flash, a puff of smoke and a loud report; and taped recordings of bird vocalizations.

Of all these strategies, two have proved most effective. Shotgun-fired exploding shells are most effective when a bird is actually killed occasionally, thus preventing habituation. The other very effective technique, taped vocalizations, are of two types: distress calls and alarm calls.

Distress calls are high-intensity calls given by restrained birds, and are commonly recorded by trapping a bird of the species in question and holding the captive in hand while recording. **Alarm calls** are given by birds when they sense danger from a predator and are used to alert other members of the species to danger. The problem with taped vocalizations is, of course, habituation.

A combination of taped distress and alarm calls and the Shellcracker shotgun approach works better than either method alone. In Great Britain, taped distress calls have been used to raise flocks of gulls and other birds which are feeding on the ground, followed by Shellcracker explosions nearby to disperse the birds.

Some Caveats

All of this sounds easy enough, until bird scaring theory collides with reality. Larkin warns airport managers that they need to be sensitive to the possibility of violations of local noise codes, game and migratory bird laws and environmental laws.

There are less predictable biological considerations to be dealt with, too. The success of a bird-scaring effort depends on the traffic density of birds at the airport at different times of day. Early and late in the day are peak feeding times for birds, necessitating some unusual scheduling for bird control personnel.

Larkin also recommends that the strength of the birds' motivation be taken into account. Some municipalities have tried to site dumps near airports, hoping to group garbage nuisance and noise nuisance together. Unfortunately, this means birds have a stronger motivation to stay near the airport, and habituation, as in the case of a Hyannis, Massachusetts dump, occurs rapidly even when vocalizations and shot shells are used.

Birds are scared and dispersed by people, not gadgets and stimuli.

Other complications to a uniform bird-scaring approach occur because species differ in their responses to playbacks. Herring gull cries are ineffective when played back to Ring-billed gulls. In some cases, distress and alarm calls will have to be species-specific. Birds may also complicate matters by initially approaching the source of the calls or by delay in responding to a stimulus. Bird control personnel must ensure that final dispersal has been achieved. Even then, final may not be final. Herring gulls have returned 30-45 minutes after being driven away by distress calls.

Dr. Larkin makes these final comments: "First, none of the bird-scaring techniques are effective at night against birds roosting or owls hunting near the runway. Second, the size of modern airports often makes the goal of seeing birds and moving them off the runways unrealistic. They may simply move from one runway to another. Third, and most importantly, birds are scared and dispersed by *people*, not gadgets and stimuli. The most successful bird-scaring efforts have been conducted by trained, motivated, and resourceful people who are willing to take the behavior and biology of birds into careful consideration before acting.

Birds (and Planes) Enroute

The problem of collisions once airborne (the "enroute" problem) is one of encounters with birds that are engaged in long-distance migration and shorter-distance local movements, such as feeding flights, homing and other activities that bring birds into altitudes frequented by aircraft. Enroute collisions are of particular concern to the military because of training flights that take place at low altitudes frequented by birds.

Dr. Quine talks about the two approaches used to reduce the enroute problem: "One approach is to warn the flight crew of potential collision hazards. The other is to make the aircraft more visible or salient to flying birds. Birds are known to avoid aircraft by veering away from them just before the aircraft passes. But the opposite problem exists as well: birds may be attracted to aircraft. Good documentation exists showing large-scale kills that occur at illuminated communications towers and at airport ceilometers during periods of heavy bird migration."

The best bird-warning devices may be visual stimuli mounted on aircraft. Reactions to a 200 watt narrow-beam incandescent spotlamp mounted on a tracking radar have been documented out to beyond 500 meters. An aircraft-mounted light or strobe need only illuminate a very small area in the flight path of the aircraft, so that such a device could be compact and consume little power.

Warning aircraft and pilots of bird hazards is now the focus of efforts by Drs. Larkin and Quine. Although birds represent radar targets with certain definable characteristics, radars need not be specially adapted to detect birds. Echoes from birds are easily detected on radars designed for detecting weather and aircraft. Which brings us to NEXRAD, the acronym for a joint radar weather detection system now under development by the Departments of Transportation, Commerce and Defense.

NEXRAD

NEXRAD will replace present systems being used by these three agencies with a single comprehensive system of radars that will cover the continental United States at 200 km intervals. Its primary purpose is weather-detection. However, research at the Natural History Survey shows that it can be adapted to detect bird targets at long range.

The system consists of three stages: radar hardware and data collection equipment, a computer system of substantial power, and user locations where additional sophisticated computers will be located.

Most of the NEXRAD design work now underway consists of designing and testing computer programs to meet user needs. In studies for the U.S. Air Force, Drs. Larkin and Quine are investigating the feasibility of providing real-time warnings of the presence of hazardous birds to flight controllers and ultimately to aircraft pilots.

Birds or Weather?

Radar hardware detects a signal in the form of an echo positioned in a certain place in the polar coordinates of the radar at a certain time. The problem is then classifying the echo — determining whether it is water, airborne debris, birds, bats, insects, etc.

The success of a bird-scaring effort depends on the traffic density of birds at the airport at different times of day. Early and late in the day are peak feeding times for birds.

Several factors make identification of biological targets a possibility. While formulae describing the likelihood of bird occurrence are more complex than weather formulae, larger amounts of information on bird behaviors exist than information on meterological targets. For example, roosting flights of many species of blackbirds are a significant bird hazard. They occur during a well-defined period just after dawn and just before dusk. According to Larkin, "Hazardous weather phenomena are seldom if ever confined to such a strict schedule."

Bird targets sometimes show on radar with identifiable distribution in space. They are often confined to certain altitude regions, or associated with certain topographic features or certain habitats. Localized targets, unlikely as weather patterns, at certain times of day and year can represent potentially lethal dense flocks of birds or smaller gatherings of large species.

Bird targets also have a rather predictable annual and daytime distribution. In addition, flying animal targets fly through the air around them, in contrast to passively-moving meteorological targets.

Observations on birds engaged in long-distance nocturnal migration were performed by Natural History Survey researchers using a prototype radar for NEXRAD. The radar system used was the CHILL unit located at Willard Airport near Champaign. Additional support for their observations was later supplied by the U.S. Air Force.

Night Flying

When many birds move long distances over land, they usually do so at night. They take to the air at sunset, usually flying for several hours before descending sometime after midnight. The researchers found several characteristics of these nocturnal migrants, which when coded into a NEXRAD algorithm, would allow real-time warning of hazardous concentrations of birds. These included stronger bird echoes than clear air or insect echoes; the confinement of bird targets to altitudes below 2000 feet (most weather echoes will have components at much higher altitudes); time of year; time of day; and wind direction. Certain species also form highly distinctive radar patterns.

The Survey researchers are now engaged in collecting even more data on distinguishing birds from weather to build a better warning system for NEXRAD use. Long-range components of their studies include evaluation of geographical differences for bird targets. Some birds, for example, will not fly over water.

The significance of the Survey's work doesn't really sink in until the magnitude of just one bird hazard is appreciated. "A single goose can destroy a jet engine," says Dr. Quine. "A flock of geese can disable several expensive jet engines, disabling an aircraft, with possible loss of life."

This article was excerpted from the work of Drs. Ronald Larkin and Douglas Quine. Dr. Larkin is an Associate Wildlife Ecologist at the Natural History Survey. He received his Ph.D. from The Rockefeller University in New York, and has been with the Survey since 1980. Dr. Douglas Quine is an Associate Biophysicist at the Natural History Survey in the Wildlife Section. He received his Ph.D. from Cornell in 1979, and has been with the Natural History Survey since 1984.

The Big CHILL

A $2 million renovation of a sophisticated weather radar system called CHILL is scheduled for completion this year. Once the Chill Radar system gets its new lease on life, compliments of the National Science Foundation (NSF), University of Illinois, and the State of Illinois, it will operate as a national facility available to scientists located anywhere in the country, for all types of meteorological research and education either at its site in central Illinois, or at locations of major national experiments.

Stanley Changnon, Principal Investigator on the CHILL project, said, "Willingness of NSF to make a highly unusual five year commitment of $1.4 million to the Water Survey for the CHILL radar reflects on the many unique ways the radar can sense different atmospheric conditions — including hail, rainfall rates and total amounts, wind movement, small ice particles, and even insects."

The CHILL radar (developed by the University of CHicago and the ILLinois State Water Survey) is owned, operated and maintained by the Water Survey. It was used in numerous weather research projects across the nation from 1972 to 1984 until age and heavy use took its toll. In 1984 a decision had to be made to either rebuild the CHILL, or scrap it.

As a last effort, the Water Survey

An inflated protective radome covers the CHILL radar at the University of Illinois' Willard Airport at Savoy near Champaign. At right is a truck van that houses the radar's controls

Antenna and pedestal of the CHILL radar system. The massive radar is 40 feet high and the antenna "dish" is 28 feet in diameter.

invited 18 scientists and radar engineers to Champaign to help plan the scientific, engineering and management aspects of the CHILL as a national facility. The recommendation was proposed to the NSF and it awarded funds for two years of renovation and then three years of operation. Now, major hardware is being replaced and more advanced data handling and control equipment is being installed in the system.

"This continuation of funds to operate the radar as a national research facility," said Changnon, "is also a sign that the Water Survey had performed its role well as host facility for the CHILL in the past."

The CHILL radar was first used in the National Hail Research Experiment, but its meteorological capabilities are much more extensive. As a weather research tool, the CHILL system has special features that can detect and plot storm movements and characteristics.

"The dual-wavelength and Doppler velocity features measure rainfall, hail and in-cloud wind speeds toward and away from the radar," Changnon said. "These features can also be used to track migrating insect pests in their relation to weather. The radar can also detect different shapes of particles, allowing inferences about the presence of ice and water particles in clouds."

The Doppler feature can detect potentially dangerous forces that are developing inside storms but cannot be seen by the naked eye. Changnon said research using the CHILL produced results that aided in designing future operational radars by significantly improving the accuracy and timeliness of severe weather warnings. Many features of new national weather radar, set to be purchased and installed in the next five years across the U.S. by the National Weather Service, were based on CHILL capabilities.

Air turbulence, such as wind shear, which has been responsible for many aircraft accidents and deaths in recent years, can be measured by a radar such as CHILL.

Air turbulence, such as wind shear, which has been responsible for many aircraft accidents and deaths in recent years, can be measured by a radar such as CHILL, added Changnon. However, work toward this for future radars is still in the developmental stage.

"Illinois is the perfect location, climate-wise, for a national weather facility," Changnon said. "Practically all forms of precipitation common to North America occur here over a 12-month period." Besides the climatic advantages, the support facilities available at both the Water Survey and the University of Illinois will contribute a great deal to the CHILL's standing as a national facility. The Water Survey has an extensive inventory of weather instruments and a long history of experience in using them. Its computer facilities, coupled with similar systems in the University's Department of Astronomy and Atmospheric Science, will provide the capability for analyses of routine weather data and satellite data to assist forecasters and researchers in their projects, as well as allowing on-site review and analysis of any radar data collected. The computer systems will also be available for post-operational review.

What if a research project requires data at a geographical or climatological setting not available in Illinois? The CHILL is a movable system. It takes about three days for workers and a crane operator to take apart the 60 tons of equipment and then transport it on flat bed trailers. From 1971 to 1981 the CHILL was moved 25 times to seven different sites in Illinois, Colorado, Oklahoma, Michigan and Montana.

CHILL's Operation

There will be four components to the CHILL's operation as a national facility. The first two of these are research related. The radar will be used as an operational data collection system for various research projects. It will also be used as an experimental-developmental tool to test new techniques, processes and equipment.

The third component will be devoted to educational purposes at its home base in Champaign. Likely activities are demonstrations for meteorology and engineering classes, training workshops for graduate students specializing in radar meteorology, cloud physics, and mesoscale weather conditions, and as a site to educate engineering students in remote sensing and systems design, system modification, and collection of small data sets for component research.

The fourth component of the CHILL operation is maintenance. Out of every year, three months will be spent on routine maintenance, and hardware research and development.

As a weather research tool, the CHILL system has special features that can detect and plot storm movements and characteristics.

Requests to use the CHILL will be reviewed by an advisory panel to resolve any conflicts. Another group composed of users of the facility and other scientists who have research interests with the CHILL will meet periodically to deal with future developments of the system, especially as they relate to existing or anticipated research needs.

Stanley Changnon, Chief Emeritus, is a Principal Scientist in the Climate and Meteorology Section at the Illinois State Water Survey. Changnon heads up the PACE field program, which used the CHILL radar in an experiment this summer. (See related article in Currents section.)

Dave Brunkow of the Climate Information Unit of the Water Survey controls the CHILL radar from a nearby van. The tape drives in the background record data gathered by the radar.

CHILL features

The CHILL radar has specialized research-oriented features that separate it from conventional weather radars.

1) The dual-wavelength feature of the radar is what makes it useful for hail research. The radar sends out signals at two wavelengths. One reacts differently to large raindrops or hailstones. By electronically comparing the two signals from a storm, the presence of hail can be detected. This capability is very useful in cloud physics and weather modification research.

2) The CHILL was designed with a Doppler processor, which permits the measurement of the velocity of a target toward and away from the radar. Doppler radar is very useful in detecting and measuring air motions within storm systems, particularly in severe storms like tornadoes. This is useful not only for meteorological applications, but also for biological applications as well. The CHILL has been used to study the flocking patterns and flight speeds of certain species of birds during the late fall.

3) CHILL has the ability to switch polarization of the radar signal. By switching polarization of the radar beam while scanning an object, the shape of the target such as a raindrop or ice particle can be determined. (Raindrops are not usually round, but slightly oblong in the horizontal.) Differences in the presence of raindrops and ice particles are helpful in determining whether cloud seeding is producing effects inside clouds. This was applied to the 1986 cloud seeding experiment in central Illinois.

With these three features, it's easy to see why the CHILL is a valuable remote sensing tool for cloud physics, storm detection and other applications.

The Endangered Pines

Up to 90,000 pine wilt nematodes are carried in the breathing pores of the sawyer beetle shown here.

In 50 of 102 Illinois counties, a recently recognized disease called pine wilt has become epidemic, threatening the state's Scotch and Austrian pines. The disease is caused by the pinewood nematode, *Bursaphelenchus xylophilus,* a small roundworm carried by a sawyer beetle, the Carolina pine sawyer. When the disease strikes, it kills quickly. The most prominent symptom of pine wilt is the decline and death of the entire tree within a few weeks or months after the first signs of the disease.

History

According to Dr. Jim Appleby of the Illinois Natural History Survey, pine wilt was discovered in the United States in Columbia, Missouri in 1979. The disease was epidemic in Japan for over three decades, decimating much of that country's red and black pines. A much earlier mention of the nematode in this country was made in 1934 in Louisiana when the roundworm was found in a dead longleaf pine. In 1934 it was not associated with the cause of a disease.

Jim Appleby explains the significance of the disease to Illinois: "The disease has been found in almost all of the states east of the Rockies and in California. But Illinois has experienced a dramatic increase in the disease in the southern two-thirds of the state. The nematode has been found in dead pines in half of all Illinois counties and is probably present wherever there are substantial numbers of pines. Scotch, Austrian and red pines are particularly susceptible to the disease."

Drs. Jim Appleby and Hassan Oloumi-Sadeghi from the Natural History Survey, Mr. Katsumi Togashi, a visiting Japanese biologist, and Dr. Richard B. Malek of the University of Illinois are conducting research experiments on the interactions between the nematode and the beetles. They note that pine wilt does appear to be associated with increases in population of a tree species in an area of the country with few native stands of conifers. Other factors include aging of the pines, increases in the beetle population, and an overall weakening of the pines by drought stress and severe winters in the 1970's. To add to the destruction, as more wilt-killed pines remain on the ground, the beetles and the nematodes have an even larger breeding habitat.

In Illinois pine wilt was first discovered near Collinsville in Madison County in an Austrian pine. Scattered pine wilt losses were uncovered in and near the University of Illinois campus at Champaign, at the Dixon Springs Agricultural Center in Pope County and in the Morton Arboretum in DuPage County. Over 300 cases of pine wilt, representing only a small fraction of actual fatalities, were confirmed during 1980-1982, and 85 percent of these were in Scotch pine, the dominant landscape, windbreak and Christmas pine in most areas of Illinois.

Symptoms

Native American pines are relatively resistant to the pinewood nematode. This is not the case in Japan, where the native pines are very susceptible. Pine wilt in Illinois is most common in the widely planted Scotch and Austrian pines which are not indigenous to Illinois. The suddenness of tree death after infection with the nematode is the most startling symptom of the disease.

Symptom development is most rapid during the warmest months of the year, when the needles die seemingly all at once. The foliage of the tree turns rapidly from green to yellowish green and then to yellowish brown and then to total brown as the chlorophyll disappears from the needles. The wilt-killed tree may stand out prominently among healthy pines.

When the disease strikes, it kills quickly. The most prominent symptom of pine wilt is the decline and death of the entire tree within a few weeks or months.

Most mortalities occur from late summer to late fall. Some trees may survive the winter, with dead branches standing out among the healthy portions of the tree. The second peak period of tree mortality is during the spring.

The Disease Cycle

Three different organisms are involved in the pine wilt disease. The sawyer beetle, considered one of the worst pests by the timber industry, lays eggs under the bark of dead trees in summer; the larvae tunnel into the wood. Beetle larvae and the parasitic nematodes spend the winter in the wood. In spring, the beetle larvae pupate in the wood and the nematodes accumulate there and enter the beetle's breathing pores. Up to 90,000 nematodes can live in one beetle. The adult beetle then chews its way out of the wood in June and July, carrying large numbers of nematodes in a quiescent state in its respiratory system.

Soon after its emergence from the dead wood, the beetle flies to a healthy pine and feeds on the branches. The nematodes enter the live pine through these feeding wounds and migrate to the resin canals where they reproduce very rapidly, resulting in a virtual population explosion.

The nematodes spread throughout the canal system, into the trunk and virtually all the branches and even into the roots. The resin flow stops and the tree dies. Bluestain fungi then invade the dead wood, and the nematodes feed and reproduce on these fungi.

Finally, female sawyer beetles are attracted to the wilt-killed pines for egg-laying and the disease cycle begins again.

Prevention and Control

One of the most effective steps in preventing the spread of pine wilt is sanitation. Homeowners should be aware of the need to destroy diseased wood before beetle emergence. The wood can be burned, or in the case of city-dwellers, can be chopped and put into a disposal area covered by soil. The wood should not be stored for firewood. Dead pines should be removed in a radius of three miles for maximum protection of new plantings.

Appleby also suggests that homeowners plant a variety of pine trees and move away from the Scotch pine and into white pine and spruces.

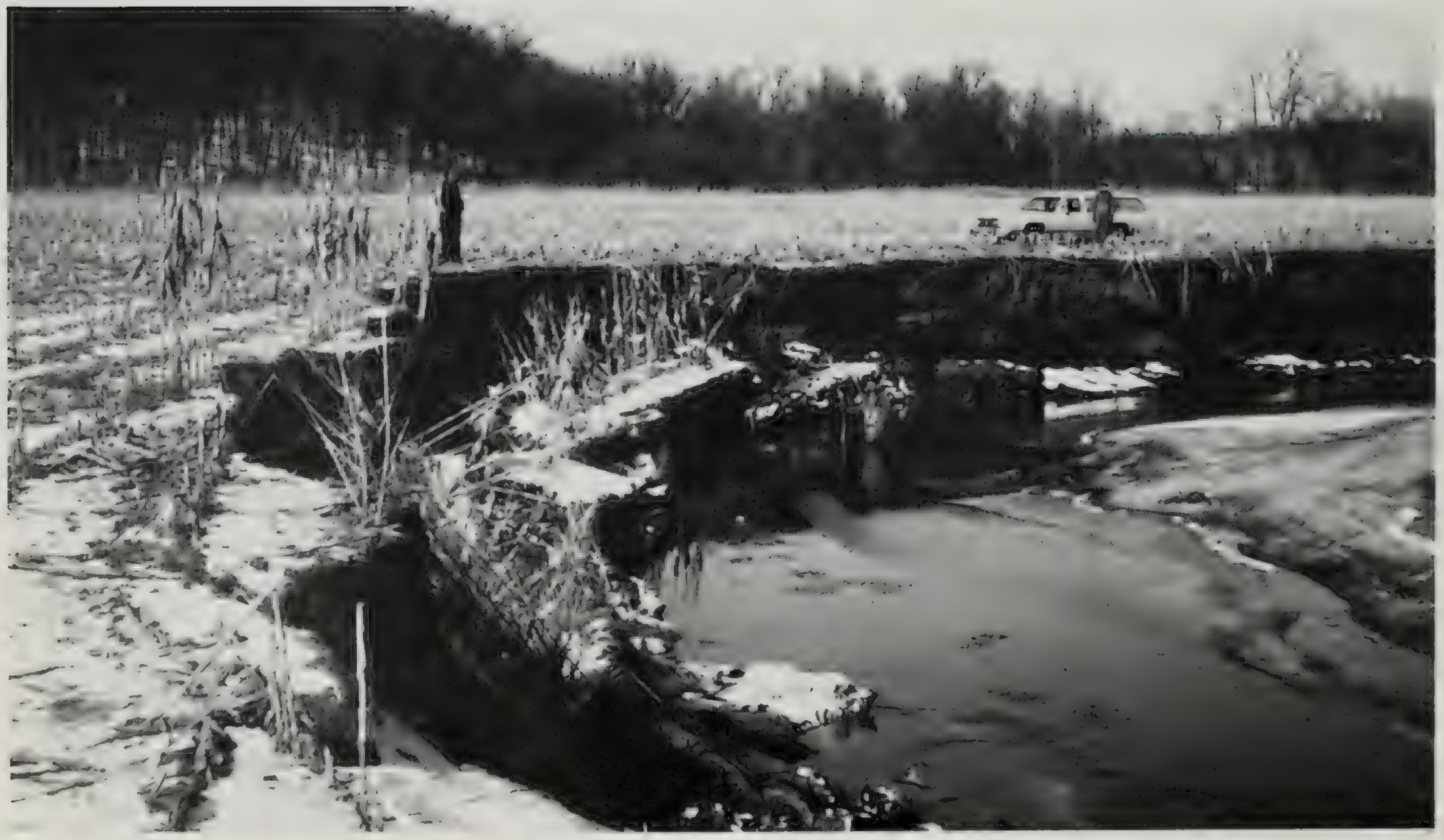
The pine pathology team from the Natural History Survey and the University of Illinois is now concentrating on discovering a weak link in the biology of the sawyer beetle that carries the nematodes and on the life cycle of the nematode itself. They know that the adult beetle may live as long as two months — and that no insecticide will last that long without causing other serious side effects. The answer may be a nematicide — controlling the pine-wilt nematode itself. In the meantime simply controlling the spread of the disease is the order of the day.

This article is based on articles by Dr. James E. Appleby of the Illinois Natural History Survey and Dr. Richard B. Malek of the University of Illinois. Dr. Appleby is an Entomologist at the Survey and an Associate Professor in the Department of Forestry at the University of Illinois. Dr. Malek is an Associate Professor of Nematology at the Department of Plant Pathology at the University of Illinois. Dr. Appleby is the Principal Investigator of the team that also includes Dr. Hassan Oloumi-Sadeghi of the Survey and Mr. Katsumi Togashi, a visiting Japanese scientist.

Slip, Sliding Away

Illinois soil is sliding in and floating down the state's waterways at an astonishing rate, as streams and rivers cut their natural paths through the earth. Landowners now suffer more damage from this activity, researchers have discovered, than from flood waters submerging row crops such as corn and soybeans.

The problem of stream bank erosion — where rapidly moving water cuts away portions of a bank — and low-cost ways of combatting it are being studied by Illinois Water Survey scientists under a research program funded by the Illinois Department of Conservation. The Court Creek Watershed in Knox County (west of Peoria) is the site of the study. At 62,000 acres, almost 100 square miles, this watershed is the largest studied in



Two rows of corn are shown washed into the stream channel of Court Creek in February 1986.

the state for the effects of land use on water quality. It is located in the center of the Illinois River basin, which was labled, "the critical sediment producing area of the Upper Mississippi River Basin," by the U.S. Soil Conservation Service. Most of the streams in this area are tributaries of the Illinois River.

"It flows so slowly that much of the sediment is deposited within the river's floodplain, especially its backwater lakes, such as Lake Peoria, Senachwine Lake, and Wrightman Lake," said Don Roseboom, Principal Investigator on the project for the Water Survey. "Sedimentation affects stream quality by interfering with its biological, chemical and physical conditions, which determine a stream's ability to function as habitat for fish and wildlife, to convey runoff, and to meet recreational needs."

Roseboom said efforts have been underway to control sediment problems by altering cultivation practices in the fields. "This has been somewhat successful. But it is important that ALL agricultural lands — including pastures — be studied to explain the outpouring of sediment and nutrients that are degrading lakes and streams throughout the Illinois River basin."

In the Illinois River basin much of the high velocity runoff originates from steep bluff areas, which are not in row crops. This high velocity water is the force which erodes stream banks from downstream floodplain fields. The Water Survey's study suggests that as preventative measures, land management practices should be re-examined. Pasture management, conversion to forests and construction of brush dams along steep bluffs should be looked at as possible practices.

"For eroded areas that need restoration, several stream bank stabilization techniques are under study in the second phase of the project," Roseboom said.

The first phase of the project began in 1981 as the Water Survey tried to correlate the acreage of row crop fields upstream in the Court Creek Watershed to the amount of sediment measured in the Waterway. The figures did not add up. Soil washed from farm fields did not account for a large portion of the sediment in the stream.

The Water Survey measured bank erosion during three storms at seven sites in the Court Creek Watershed. According to findings, 600 to 2,500 tons of soil eroded from the seven stream bank sites during each storm.

These figures alone accounted for 5 to 10 percent of the sediment washed into the stream from the entire 62,000-acre watershed. "What's more," Roseboom added, "the seven sites represent only a small portion of the bank erosion occurring in the watershed."

The Water Survey identified two factors: high-velocity streamflows and unstable stream banks as the major contributors to poor stream quality and severe erosion damage to the floodplains.

"One of the factors that can intensify stream bank erosion is channelization," Roseboom said. This is a process in which a meandering stream is straightened to make an adjoining field larger and more uniform. "The problem is that streams meander naturally, and once straightened, they will begin immediately to cut back into the land," Roseboom said. "In addition, when a stream is straightened, the speed of its flow increases, giving it more power to erode stream banks."

Roseboom said they compared 1940 aerial maps of Court Creek with 1979 maps and found that major stream bank erosion sites were located where the stream had been straightened. However, the study found that channelized streams with wooded banks did not suffer from intense erosion. The stability of the stream channels with wooded banks is clearly demonstrated in that series of aerial photographs.

"A landowner who was losing large pieces of his stream banks planted willows along the banks during the dry years," said Roseboom. "These trees grew large enough to provide protection during a 6-inch rain that fell in 10 hours. The amount of erosion in his field was minimal compared to upstream and downstream areas. A woody belt will work if it can get a good start."

The second phase of the Water Survey's study that took place this summer concerned stabilization of stream banks. "The problem of stream bank erosion is well-documented," Roseboom said, "but we're just getting started on solving it." The low cost erosion control techniques selected for the demonstration phase of the project were first used by the Soil Conservation Service in the 1930s during the WPA (Work Progress Administration) program.

The lowest cost method is largely a stream maintenance method which will use logjams and nearby trees as bank protection structures and flow deflectors. This method has been successfully applied in other states by private consulting firms. The large logs are cabled to the bank. Once sediment gathers among the logs, trees are planted to provide "natural" stabilization.

At sites where this method is not sufficient, the project will attempt to reestablish the tree line by planting large dormant cuttings of willow and cotton wood in the eroding bank. The dormant cuttings will regrow root systems and branches to stabilize bank soil and deflect streamflow.

The Soil Conservation Service in Arizona has successfully used this method in major rivers, including the Colorado River. It is more expensive than the first method because usually a large number of cuttings must be transported to the site.

Once the stream stabilization methods have been applied, the Water Survey will monitor stream stability through a series of stream cross-sections and aerial photographs.

"The problem is that streams meander naturally, and once straightened, they will begin immediately to cut back into the land."

"The development and maintenance of the low-cost methods will require the long-term commitment of local residents," Roseboom said. "Landowners have already demonstrated their real concern about the extensive damages by forming a watershed steering committee." The committee is administered by the Knox County Conservation District. Landowners also have donated row crop land along stream banks for stabilization work and monitoring.

An important part of the new project is that work crews for all stream restoration methods will include local residents, who will be trained in application and maintenance of the methods. In this way watershed landowners can maintain the stabilized stream channels after the contractors and government agencies are gone.

The Water Survey will incorporate the suggestions of participating landowners and photographs of the stream work in educational materials to be published for landowners in other watersheds, Roseboom added.

Don Roseboom is Principal Investigator on the Illinois State Water Survey's Court Creek study. Water Survey staff who also worked on the study include Ralph Evans, John Erickson, Lyle Brooks and Dana Shackleford.

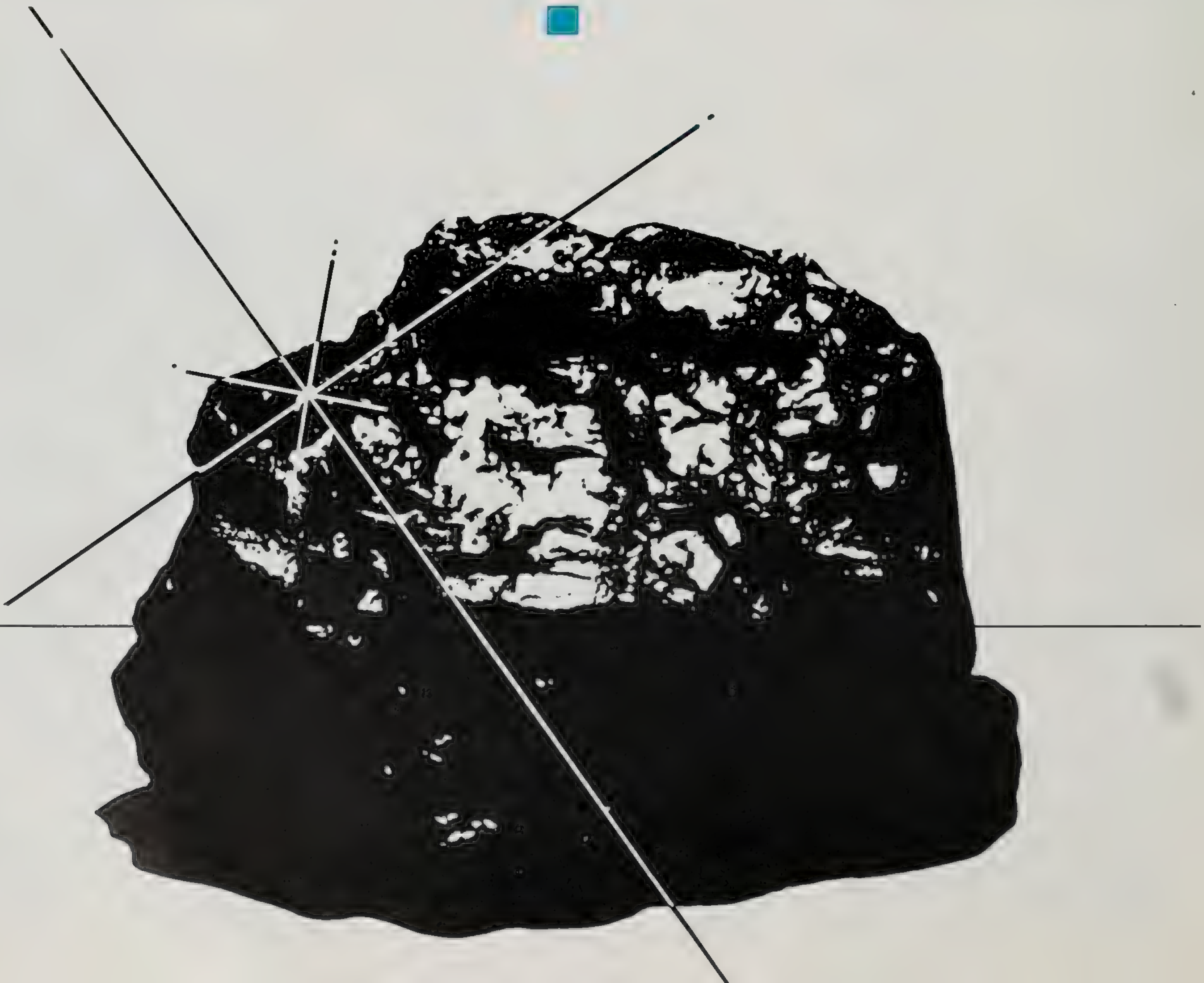
Illinois' Black Treasure

Illinois possesses the largest recoverable reserves of bituminous coal in the United States, with 181 billion tons of coal underlying 60 to 70 percent of the state.

Texas has its oil, Florida has its citrus, and Illinois has its corn and soybeans. But the Prairie State also has coal, an underdeveloped asset, which if fully developed could mean a stronger economic climate for the people of the state.

Illinois possesses the largest recoverable reserves of bituminous coal in the United States, with 181 billion tons of coal underlying 60 to 70 percent of the state. Developing this resource provides a tremendous economic opportunity for the residents of Illinois. Illinois coal is considered to be "high sulfur" coal.

The Illinois Geological Survey in Champaign-Urbana is working on ways to increase the use of coal through a number of research projects, primarily



concerned with the removal of sulfur from coal. Sulfur must be removed from coal either before burning or after burning to assure an environmentally safe practice.

"Most of Illinois' coal resources have a relatively high sulfur content, ranging from three to five percent sulfur," said Henry Ehrlinger, Minerals Engineer at the Geological Survey. "About half of the sulfur in the coal is pyritic and half is organic. We can get rid of about 80 percent of the pyritic sulfur, but the organic sulfur which is chemically part of the coal cannot be adequately removed with the same processes used to remove pyritic sulfur."

"There are two approaches for removing organic sulfur from coal," said Carl Kruse, Senior Research Scientist. "One is to catch the sulfur after it has been burned, which is post-combustion, or to remove it before it is burned by pyrolysis, solvent extraction or microbial desulfurization."

The Illinois Geological Survey is one of several coal research facilities in Illinois which is part of the Center for Research on Sulfur in Coal (CRSC). Some of the other contractors are: University of Illinois, Champaign-Urbana; University of Illinois, Chicago Circle Campus; Southern Illinois University, University of Chicago, Argonne National Laboratory, Northwestern University and a number of others. The Center coordinates the efforts of the contractors thereby avoiding duplicate effort and assuring that the solutions to the sulfur in coal problems are resolved with the most efficient use of talent and funds.

Major Research Projects in Progress

Fine Coal Cleaning or Aggregate Flotation

"For our project," Ehrlinger said, "we are using equipment already commercially available, but drastically changing reagents to maximize coal recovery while rejecting pyritic sulfur and ash. We believe this approach is economical, practical, and has an excellent chance for commercial acceptance." The Minerals Engineering team has batch and pilot scale equipment in use at the Survey. After three and one-half years of research the process is almost ready for commercial application.

The Aggregate Flotation process involves the forming of aggregates of very fine coal while rejecting, by selective wetting, the pyrite and ash constituents in the coal.

The Run of Mine coal is wet ground to liberate the pyrite and ash, then treated with reagents for the coal selectivity and to form a froth as air is introduced into the agitating slurry. The clean coal attaches to the bubbles and is skimmed off, while up to 80 to 90 per cent of the pyrite and ash are drawn from the cell as a waste product.

Thermal, Chemical and Magnetic Desulfurization of Coal

A new approach to desulfurize Illinois coals combines thermal (heat), chemical and magnetic steps. Basically, coal is heated to temperatures high enough to liberate oil and gas. During this heating step, significant amounts of sulfur are also liberated. Some of the remaining sulfur is removed by chemical treatment which employs hydrogen gas. Some of the remaining sulfur is removed magnetically along with iron. The integrated three-step approach is anticipated to remove enough sulfur from many high sulfur Illinois coals to produce a compliance-level coal-derived fuel. This would allow for the direct combustion of this fuel without the need for sulfur dioxide scrubbers. Mike Stephenson, Associate Chemical Engineer, is project manager of this activity.

Microbial Desulfurization

"What is unique about the research at the Geological Survey," said Kathy Miller, Assistant Geochemist, "is this technique has never been tried on coal char, and only sparingly on coal."

One part of this project attempts to use microbe bacteria to remove the sulfur from coal char. These tiny bacteria attack the pyrite sulfur in coal and use it as a growth mechanism, or food.

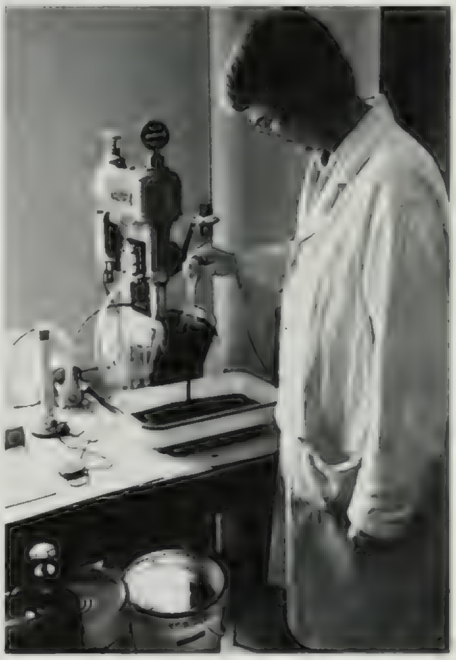
Before the image of micro-organisms attacking and eating sulfur out of the coal begins to sound like a fantasy science fiction thriller, note that the microbial approach has been used successfully in benefication processes for other minerals, such as copper. Early results have shown that about 90 per cent of the pyritic sulfur can be removed from coals, and about 55 percent can be removed from char.

"A second portion of the project is attempting to use a thermophilic organism which grows at 158°F to remove organic sulfur. So far the results are inconclusive," Miller said.

A new project will combine microorganisms in the physical coal cleaning process. Iron and sulfur oxidizing organisms will be mixed with physical cleaning feed to alter the surface of the pyrite to make it less floatable.

Carbon Monoxide — Ethanol Desulfurization of Illinois High Sulfur Coal and the Demonstration of the Process as a Continuous Unit

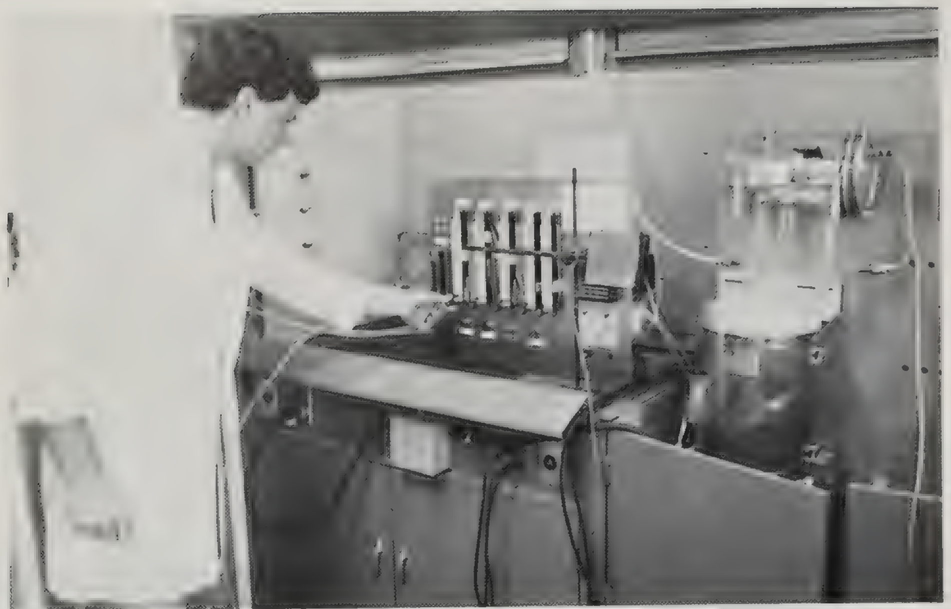
These two projects — one is aimed at research, the other at commercial development — are funded by the Illinois Corn Marketing Board and Exxon Overcharge Funds. "The technique works," said Dick Shiley, Organic Chemist. "We are trying to streamline the process to get a better handle on the economics." The process involves using ethanol, a corn product, to remove the organic sulfur. To remove the inorganic sulfur, magnetic separation would be used, or the coal used should be pre-washed. The by-products of the process can be used for cogeneration. This particular process can be done at the mine site, rather than at the plant site.



Larry Camp, Associate Staff Chemist, skims off froth containing clean coal in the aggregate flotation project

Since Illinois is a leading corn producer, this method would be a boon to the Illinois economy. It would take approximately 690 million gallons of alcohol, or 20 percent of the Illinois corn crop, to desulfurize 60 million tons of coal by this method. "Scott Bidner of the Corn Marketing Board said the idea is to 'get the farmers out of the hole, and put the miners back in'," said Shiley.

The next step is to build a demonstration unit and eliminate some pro



In the Thermal Analyses Lab Dave Moran, Assistant Chemical Engineer, uses the Thermography Metric Analyser (TMA) to measure sulfur dioxide absorption reactivity.

cedures to make the method cost-effective.

Combustion Characteristics of Coal Char

This project, just started, explores the combustion activity of low sulfur char. Can it be burned, and if so, what are its characteristics? The Survey is doing the research in conjunction with Argonne National Laboratory and the University of Illinois' Mechanical Engineering Department. "This is an alternative to removing the sulfur before combustion," said Massoud Rostam-Abadi, Associate Chemical Engineer, who is in charge of the project. "If we can't get the sulfur out before the coal burns then we need something to remove the combustion gases after."

The research is done on a very small scale — currently they are using one gram of coal — on very sensitive equipment in the Thermal Analysis laboratory. The fundamental characteristics of coal are looked at, such as its softening characteristics. Everything is computerized in the lab to increase productivity, accuracy and data collection transfer.

Support Effort

There are three programs in place at the Geological Survey which provide valuable support to the specific research projects on the sulfur content in coal. The three programs are the Coal Sample Program, the Coal Information System and Coal Analysis Support.

Coal Sample Program

The Coal Sample Program, started in 1983, by the Illinois Coal Development Board, provides uniform samples of Illinois coal to facilitate comparability of results. It is important that the research projects utilize samples from the Coal Sample Program. This strengthens the overall CRSC program by allowing project-to-project comparisons of results, decreasing the time required for sample selection and gathering, and reducing the cost by providing an analytical data base on each sample. There are three tons of coal in each of the several samples. They are available free of charge to those doing research on coal. The project is administered by Carl Kruse.

Coal Information System

This program provides valuable information about coal in the Illinois Basin to researchers throughout the state. It is a computerized program and is capable of supporting on-line users at remote terminals. The project was initiated with two objectives in mind: to determine useful characteristics properties of the samples and to establish a computerized information system.

The properties determined are various petrographic, mineralogic, and minor and trace element analyses. These data together with the more standard chemical analyses are incorporated in the data base. In addition, the data base includes information about the users of the samples that will promote collaboration among users and help them and others plan future projects using these samples. Richard Harvey, Senior Geologist, is the Principal Investigator for this project.

Coal Analysis Suport

"We examine the products from the research projects, and provide accurate and timely analyses of these products," said Chusak Chaven, Associate Chemist, who, with a crew of five, conducts coal analyses which include moisture, ash, fixed carbon, BTU's, and varieties of sulfur. Chaven recently developed a method of analysis for the forms of sulfur which helps to increase the scope and productivity of the laboratory. During the last several years, the Survey has been able to purchase the latest scientific equipment which has aided the group both in accuracy and volume.

Summary

All research projects described began at a very small scale. After developing guidelines, they advance into a continuous flow or pilot plant stage, and they have commercialization as an ultimate goal.

"If it fails, it is better that it fails here in the laboratory rather than on a large scale" said Massoud Rostam-Abadi.

By having geologists, chemists, and engineers working on the sulfur in coal research projects, the Geological Survey believes it is taking a "real world" approach to the problem. "We are not just doing research in an ivory tower that can't be applied anywhere else," said Kruse. "We have a team of chemists and engineers working together for solutions that are economically and technically sound for industrial use. The engineers know how to take the analytical data and apply it."

Illinois' coal reserves could mean invaluable riches to this state's economy, but only if the research on sulfur in coal can produce an economically viable way of using coal as a fuel source in the commercial sector. Illinois Geological Survey staff are working hard to meet that goal.

Illinois State Geological Survey staff engaged in coal research who were contributors to this article include Henry P. Ehrlinger III, Mineral Engineer, Carl W. Kruse, Senior Research Scientist, Massoud Rostam-Abadi, Associate Chemical Engineer, Chusak Chaven, Associate Chemist, Kathy Miller, Assistant Geochemist, Richard Harvey, Senior Geologist, and Dick Shiley, Organic Chemist.

SURVEYING ILLINOIS

BIORHYTHMS

A Microscope With A Memory

Early in 1987 the NHS will have a powerful and sophisticated microscope at its service. The Amray 1830, now under construction in Bedford, Maine, is a digital-imaging, computer-controlled automatic scanning electron microscope. For the first time the NHS will have a microscope with an image storage and processing system as standard equipment.

Stream Fish Densities

Dr. Peter Bayley of the NHS has been awarded funds from the Illinois Department of Conservation for a project that will enable Department and Survey staffs to interpret the actual densities of stream fish populations from catches using stream fishing gear.

Mosquito Control

The NHS is involved in planning for a Research Center for Vector/Pest Biology and Control, aimed primarily at mosquito abatement in Illinois. The Center will focus first on Illinois and the Midwest, and then move to national and international research. The first meeting of the Center was held October 29 at Pheasant Run Resort in St. Charles, as a prelude to the annual meeting of the Illinois Mosquito Control Association.

Endangered Bat Found in Illinois

One nest of a federally endangered species of bat, more often found in Indiana, has been discovered in Illinois. Plans by the Natural History Survey (NHS) for tracking captured bats by attaching tiny radio transmitters to the animals are being made for next summer in hopes of finding more of these rare creatures.

Lead Poisoning in Waterfowl

The latest publication of the Natural History Survey, a review of lead poisoning in waterfowl, has become one of its most popular. Over 3,000 copies of the article, co-authored by Glen C. Sanderson and Frank C. Bellrose, have been requested since it came off the press in late August. Plans are now underway for a reprinting.

Educating

The NHS took part in the National Council for Geographic Education meetings at the Palmer House in Chicago October 9-12 in collaboration with the Illinois Water and Geological Surveys. A series of slides were shown detailing the educational offerings available to Illinois educators from the three Surveys.

Stannard Named Fellow

Dr. Lewis J. Stannard, Golconda, a retiree from the NHS, has been named a Fellow of the Entomological Society of America, for his outstanding contributions to the science of entomology. He and other newly-appointed Fellows will be given formal recognition December 8 at the Annual Meeting of the Society in Reno, Nevada.

GEOGRAMS

SSC Parties Meet

David L. Gross of the Illinois Geological Survey, who is head of the environmental studies portion of the Superconducting Super Collider (SSC) project, was Illinois' representative at the Third National SSC Site Conference held at Ohio State, October 31 and November 1. Representatives from each state were invited to the conference to hear speakers from the Department of Energy, which will make the decision whether to go ahead with the SSC. This decision is anticipated in January. Representatives from the design group hired by DOE to design the SSC also made presentations. The construction status of other accelerators in the world was reviewed.

The SSC will be the world's most powerful particle accelerator, a scientific instrument for exploring the basic structure of nature. It will allow scientists to "see" the subatomic particles that hold the universe together. If U.S. DOE decides to go ahead with the SSC, the country would regain its preeminence in high energy physics in the world. The SSC also means a great economic boost to the state it would be built in. This has already lead to intense competition among the states.

Ultradeep Drillhole Bills Waiting For Action

Work is continuing on the Illinois Basin Ultradeep Drillhole project (IBUD), formerly referred to as the Superdeep Drillhole. Jim Eidel, Leader for the project at the Illinois Geological Survey, has testified before the Senate subcommittee on Natural Resources, Development and Production concerning the Continental Scientific Drilling and Exploration Act that is currently before the Senate. An identical bill is before the House. The bills call for the National Science Foundation, the U.S. Department of Energy and the U.S. Geological Survey to recommend maximum and minimum budgets for a continental drilling program to Congress within six months. Senator Warner, chairman of the subcommittee, predicted action on the bill this session.

A $2 million proposal for a geophysical study to select the site of the ultradeep drillhole will be presented to the Deep Observation and Sampling of the Earth's Continental Crust (DOSECC), Inc., this fall. DOSECC was incorporated by the National Science Foundation to carry out the scientific drilling program. Eidel estimates it will take two years to conduct this study and to locate the specific site.

To date, no money has been allocated for developing the drilling technology needed for the IBUD ultradeep hole. The U.S. Engineering Foundation held a week-long meeting on the subject of U.S. drilling technology in April 1986. The Illinois Geological Survey is considering a second workshop on IBUD drill technology.

The data gathered by studying an ultradeep drillhole will provide valuable background data for scientists studying earthquakes, and oil, gas and mineral exploration. The drillhole will provide the first hard data on physical properties at such a depth, and information on which to base crustal models and predict earthquakes.

Fossil Find in Southern Illinois

An unexpected bonus of the State Geological Survey and the U.S. Geological Survey quadrangle mapping program in southern Illinois is the recent discovery of well-preserved marine fossils in a lower Pennsylvanian stratum. This important fossil find will enable scientists to make an accurate age determination of the stratum and correlate it with lower Pennsylvanian strata in other regions of the world.

In southern Illinois, most Pennsylvanian sandstones have been considered deltaic or fluvial in origin. Some marine sandstone exist, but they contain no fossils because of diagenetic leaching; the shells, which are basically calcium carbonate, dissolve over time. Yet below the Pounds Member of the Caseyville Sandstone lies a black shale containing a diverse marine fauna of four different genera and five distinct species of ammonoid cephalopods — coiled creatures that are distant relations of the present-day chambered nautilus. The ammonoids could not live in freshwater, so their fossils are evidence for a shallow sea.

"One of the goals of our surface mapping programs is to reconstruct environments of deposition," said Joseph A. Devera, a Palentologist with the Survey. "We attempt to map paleoenvironments not just rocks, using paleontology, sedimentological relationships, and often ichnology — the study of organism traces preserved within and upon these paleo-landscapes and seascapes. When we combine this information with data on the type of rocks present, we get an idea of what conditions were like millions of years ago." Devera points out that the reconstructions of ancient environments can help geologists predict where new fossil fuel resources may be likely to occur.

Map Has Popular Appeal

The Satellite Image Map of Illinois tops the "Most Requested" list at the Geological Survey. No other map or publication has enjoyed such popularity. The Satellite Image Map was created from 13 overlapping infrared and visible light photographs taken in October 1982 from the LANDSAT 4 satellite. It is the first false-color photograph of Illinois rectified to the standard U.S. Geological Survey projection of the state at a scale of 1:500,000. Rectifying the map removes the distortion caused by the tilt of the statellite. According to Christopher Stohr, an Engineering Geologist involved with production of the map, any measurements taken on the satellite map have the same precision that can be expected from a map of this scale.

False color, not true color, was used on the map because blue and ultraviolet light produce a haze that makes it difficult to see the ground clearly. This haze vanishes when false color is used. False colors also allow a better distinction between vegetation, soil and water.

The viewer is provided with an overall picture of Illinois geology, geography, topography, water supplies, and their relation to land use and agricultural practices. Also visible are small features such as airport runways, bridges, Navy Pier of Chicago, and the Assembly Hall of Urbana-Champaign; even smaller features can be seen with the aid of a magnifying glass. Such a synthesis of information has never been available for Illinois. Previously, a person would have needed to consult many types of maps to find the information combined in the Satellite Image Map.

Land-use planners, farmers, engineers, businessmen, and educators are among the people who have found this map useful.

Landslide Inventory Available

A landslide inventory program set up by Geological Survey geologists with the partial support of the U.S. Geological Survey provides quick access to information on all known landslides and landslide-prone areas in Illinois.

Landslides occur throughout Illinois, but are found primarily in areas adjacent to major rivers and lakes. Most landslides are not life threatening; however, lack of awareness or disregard of landslide potential has resulted in delay or abandonment of construction projects and in considerable property damage. Known landslides have caused more than $8 million of property damage in the state over the past 60 years.

The inventory should be particularly useful to builders, engineers, community planners, geologists, and homeowners concerned with preventing or minimizing problems that may result from landslides.

Personnel Notes

Dr. Keros Carwright has been appointed to the U.S. Committee for the International Association of Hydrogeologists. The appointment is for a three-year term, ending in September 1989.

CURRENTS

Symposium held

The "International Symposium on Drought: Prediction, Detection, Impacts Assessment and Response," was held September 29 through October 1, 1986, at the University of Nebraska, cosponsored by a number of national and international organizations including the Water Survey. Pete Lamb and Bill Easterling of the Climate and Meteorology section helped organize the conference.

Commissioned papers from an international roster of distinguished experts addressed the physical and societal implications of drought on a variety of spatial scales, from the farm level to supernational regions. These issues were addressed in the contexts of developed and developing nations. By holding a conference, organizers hope to facilitate the interchange of ideas between scientists and decision makers, identify research needs, and review the need for and development of effective drought response plans in an international arena.

Water Notes

The electronic power generation industry is the largest user of water in Illinois. This industry withdraws about 33,888.8 million gallons of water a day, but more than 99 percent of this is returned to its source with only an increase in temperature.

Unusual Ups and Downs Mark Winter of 1985-86

The winter of 1985-86 (December-February) was colder than normal throughout Illinois, and precipitation amounts were near to above normal for the northern three-quarters and about 60 percent of normal for the southern quarter of Illinois. Snow fell over all of Illinois this past winter, but it was generally light in extreme southern Illinois. The snows that did fall did not stay on the ground very long except in extreme northern Illinois.

John Vogel, head of the Water Survey's Climate Information Unit, reported that temperatures averaged 2 to 3 degrees below normal statewide this past winter, largely due to the extremely cold December. Except for December, the winter was relatively mild and few temperature records were broken.

Chernobyl Disaster

The nationwide acid rain monitoring network has provided portions of its regular precipitation samples to laboratories of the U.S. Department of Energy (DOE) for measurement of radioactive contamination generated by the Chernobyl nuclear power plant accident in the Soviet Union.

The Central Analytical Laboratory of the National Atmospheric Deposition Program (NADP) and National Trends Network (NTN), located at the Water Survey, sent NADP/NTN precipitation samples to DOE's Battelle Pacific Northwest labs in Richland, Washington, for analysis of radioactive contamination.

Samples from 45 sites in 15 states in the Pacific Northwest, Great Plains and Rocky Mountains were processed. Areas in these states had precipitation during the three-week period of April 29-May 20 that is believed to have mixed with the plume of radioactive contamination from Chernobyl.

According to NADP/NTN researcher Gary Stensland, the radioactive contamination was contained mainly in the middle and upper atmosphere, and was brought to the ground by precipitation which forms in tall clouds.

Rain in the Pacific Northwest states during the week of April 29-May 6 coincided with the first surface observations in Oregon of the plume of radioactivity from the Soviet Union.

Rains over the Pacific Northwest and later over the Rocky Mountains and the upper Great Plains intercepted the radioactive plume. The states from which samples are being analyzed are California, Colorado, Idaho, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, Oregon, South Dakota, Utah, Washington, Wisconsin and Wyoming.

Personnel Notes

Ellis W. Sanderson has been named head of the Groundwater Section of the Illinois State Water Survey. Sanderson has been Assistant Head of that section since 1980 and Acting Head since November 1985. He came to the Water Survey in 1965.

Water Survey Chief Richard G. Semonin has announced the appointment of Ronald F. Karr as Assistant to the Chief for Administration. Karr has been with the Water Survey since 1976. In his new position, Karr will continue to supervise the staff and activities of the former Financial and Personnel Unit, which will become a part of an enlarged Office of the Chief.

PACE Takes Place

Researchers of the Water Survey's Climate and Meteorology Section this summer manned radar and satellite controls on the ground and boarded aircraft to study the insides of clouds for the research project PACE — Precipitation Augmentation for Crops Experiment.

Two aircraft were used — one plane to seed clouds and the other to collect cloud physics data such as cloud temperature, ice content and droplet size. The goal of the 8 year old PACE project is to measure precipitation alterations that can be made in various growing season weather conditions, to detemine impacts of rain alterations on all facets of agriculture, and ultimately to determine the socio-economic and environmental desirability of weather modification. The CHILL radar, recently renovated (see story this issue), was instrumental in this weather modification experiment.

The radar was used to direct the aircraft to candidate clouds for seeding and in-cloud measurements. Radar data were then collected to see how the clouds behaved — their growth, longevity and rain production.

WILDLIFE

The Navajos called them "God's dogs." Biologists call them opportunists. Farmers shoot them as predators. Hunters see them as competitors. To many they are symbolic of the Old West. They are coyotes, and they are becoming more prevalent in Illinois and the eastern part of the United States.

Size and Appearance

Coyotes *(Canis latrans)* most closely resemble German shepherds in size, conformation and color. The most noticeable difference is in the tail. The coyote carries its tail below the level of its back instead of curved upward. The upper part of the body is grizzled gray or buff, the muzzle is reddish-brown or gray, and the lower parts are whitish, cream-colored or pinkish-yellow. The coyote is distinguished by a bushy tail, pointed ears and long legs. Weight ranges from 25 to 45 pounds.

Illinois coyotes have a bigger, broader muzzle and are generally larger than western coyotes. Some biologists believe that Illinois coyotes are mainly coyote, with a little bit of dog blood mixed in. The more heavily-mixed coy-dogs are primarily seen farther east.

Range and Distribution

The coyote species is found throughout most of western North America, from central Alaska almost to Panama. In the United States coyotes have greatly expanded their range over the last 25-30 years. Their movement north and east has been spurred by man's destruction of the great midwest forests. The creation of more open land drove out the eastern timber wolf and the red wolf, the coyote's chief hunting competitors.

Coyotes are most abundant in southern and western Illinois in areas with a good mix of brushland and farmland. They are less likely to be seen in forests and land used strictly for farming. The only good indication of the coyote population in Illinois is in terms of the fur harvest. In 1983-1984, 7,289 coyote pelts found their way to the fur market, 1.42 percent of Illinois' estimated total fur harvest, worth $68,516 or $9.40 per pelt.

Feeding Habits

The meat and potatoes of the coyote's diet are rabbits and rodents, with supplementary meals taken from insects, vegetable matter, birds and carrion. Individual coyotes and the occasional pack will hunt hogs, sheep and white-tailed deer. Most coyotes however prefer the easiest meal around, and that is usually rabbits and rodents.

Breeding and Social Ecology

The female coyote is choosy in picking a mate, and may reject several suitors. Coyote breeding pairs do seem to live and hunt together for many years — perhaps even for life. The female coyote has one litter per year in the spring, with an average of six pups. The gestation period for a litter is 60-65 days.

Both male and female coyotes supervise all phases of their pups' upbringing. Females nurse their young for up to two months, and males bring back semi-digested food for both mate and pups. If a female is killed, the male will raise the litter. Coyote pups are aggressive in play, much more so than dog or wolf pups. This helps establish a dominance hierarchy early and may result in the cooperation seen in coyote packs as they hunt and live together.

Coyote packs can include juveniles, parents, yearlings and other adults. Summer is hunting time for coyote packs. Coyotes have a keen sense of smell and can hunt equally well day or night. They have extremely sharp teeth, are capable of 40 mile-per-hour sprints and work together when hunting. They are formidable predators. There are also many coyotes who live and hunt very successfully as solitary individuals. The average maximum lifespan of the coyote is eight to nine years.

Outlook

Illinois' coyotes seem to be maintaining if not increasing in number. Without the competition afforded by the timber and red wolves of Illinois (now extinct) and with the destruction of more forestland and the creation of more open land, the outlook for the survival and prosperity of "God's dog" seems excellent

TRANSITIONS

Lawrence Page

Paul Risser

Page New Acting Chief

Lawrence Page was named the Acting Chief of the Illinois Natural History Survey following Paul Risser's resignation as Chief. Risser left the head position at the Survey to become Vice President of Research for the University of New Mexico in Albuquerque.

Page, an Ichthyologist, is an Affiliate Professor at the Department of Ecology, Ethology, and Evolution — as well as a member of the graduate faculty — at the University of Illinois. Formerly he was the Acting Head of the Faunistic Surveys at the Natural History Survey. His primary research interests are systematics, evolution and ecology of freshwater fishes, and natural areas. He is the author of numerous publications and articles. Page received a B.S. in biology from Illinois State University and an M.S. and Ph.D. in zoology from the University of Illinois.

Page will head the Natural History Survey during the search for a permanent Chief. The Board of Natural Resources and Conservation, chaired by Don Etchison, Director of the Illinois Department of Energy and Natural Resources, will select Risser's successor.

Risser, whose resignation was effective July 1, said he accepted the position at the University of New Mexico because of the challenge of being responsible for a broad array of topics at a major university. Much of the research he will oversee pertains to engineering, biotechnology, communications technology and medicine. Risser also may continue some of his ecological research.

ENR Director Etchison said that during Risser's five-year term at the Natural History Survey. Risser and his staff gave the institution "more visibility and recognition in the state and the nation." The caliber and size of the staff and the data collection and management systems also had improved, he added.

The Natural History staff, made up of about 230 scientific experts, is responsible for research about plants and animals of the state, and provides recommendations about the status, protection, development and use of these resources. The staff also maintains huge collections of plant and animal species.

Richard G. Semonin

Semonin named Water Survey Chief

Richard G. Semonin was named Chief of the Illinois State Water Survey, effective August 1, 1986.

Semonin succeeds Stanley A. Changnon who retired as Chief in August 1985. Richard J. Schicht, Acting Chief since that time, will continue as Assistant Chief. The Survey staff that Semonin heads includes some 200 chemists, meteorologists, hydrologists, engineers, biologists and their support staff.

"This is one of the most challenging positions of my 31 years at the Survey," Semonin said. "The quantity and particularly the quality of Illinois' water, whether underground, on the surface, or as rain, are vital for the economic growth of the state and for the health and recreation of its citizens."

Semonin began his career with the Water Survey as a radar meteorologist in 1955 upon graduation from the University of Washington. A meteorologist by formal training, he worked in various fields, frequently crossing into other disciplines important to Water Survey programs. His interests in radar meteorology led him into cloud physics and weather modification research, both in the laboratory and in the field. These studies led to an interest in atmospheric chemistry.

Semonin rose through the administrative ranks while developing a major research program in atmospheric chemistry and a specialty in acid rain. He was named Assistant Section Head for Atmospheric Sciences in 1972 and Section Head in 1980. Later that year he was appointed Assistant Chief for Administration and Research, a post he held until named Chief.

He was co-director of the Charged Particle Research Laboratory at the University of Illinois in the mid-1960s and has been Adjunct Professor of Meteorology at the U of I since 1975.

Active in the development of the National Atmospheric Deposition Program (NADP), Semonin was elected chairman of the NADP Site Criteria and Standards Committee for 1977-1979 and again for 1984-1986. He led the effort through which the Water Survey was selected to operate the NADP's Central Analytical Laboratory, which now processes weekly precipitation samples from 200 monitoring stations in the U.S. and Canada.

Semonin is a Fellow of the American Meteorological Society and of the American Association for the Advancement of Science, serving in various positions for both groups. He also is a member of the National Weather Association, Weather Modification Association, Illinois Academy of Science and Sigma Xi.

Semonin expects research at the Survey to continue to grow under his leadership. "I have always felt that the Water Survey should anticipate water and atmospheric resource problems rather than react to them after they happen," he said. "Our research and services should focus on the water and atmospheric problems that will confront Illinois in the next decade and into the next century."

Among the unresolved problems he notes are the gradual loss of lake and stream water resources to sedimentation, the potential degrading of groundwater quality, the ever-changing weather and climate stress on Illinois agriculture and other sectors of the economy, and flooding in both urban areas and the open waters of the state.

Semonin and his wife of 35 years live in Champaign; they have four children and seven grandchildren. Semonin is a native of Akron, Ohio.

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Spring Summer, 1987

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THE NATURE OF ILLINOIS

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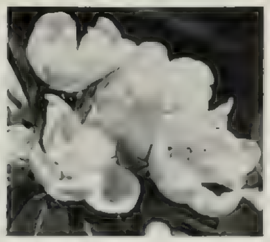
A Tempest of Whirlwinds

Tornado season is here, and Illinois ranks first in tornado-related deaths.



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Picking Apples and Pears from the Right Family Tree

Are apples pears? Botanists debate family trees.

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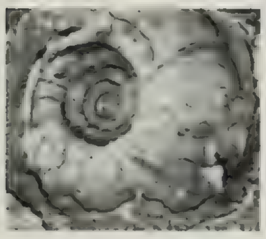
In Danger

A look at four of Illinois' endangered and threatened species.



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The Hidden Landscape

315 million years ago, shallow seas covered parts of Illinois, and an Illinois Geological Survey researcher has found marine fossils to reveal more of the state's geological history.

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Hazardous Waste in Your "Home, Sweet Home"

Oven cleaners, drain and toilet bowl cleaners, garden herbicides, motor oil and antifreeze — your house may be a source of hazardous waste, too.

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On the Board

Profiles of the Society's Board Members.

About the Cover

Twin twisters, a very unusual event, occurred March 20, 1976 near Sidney, Illinois. The entire length of the tornado, which started near Danville, was 63 miles. There was concern for people in the University of Illinois Assembly Hall since the Boys Class AA State Basketball Tournament was in progress as the tornado was hitting small towns near Champaign. Sidney is about 13 miles from the Assembly Hall. This photograph was taken by Frank Grussing of Sidney

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Editorial Staff

Jane A. Bolin
Linda Classen Anderson
Editors

ComUnigraph
Design and Production

Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 2021 Illini Road, Springfield, IL 62704.

The Society encourages readers to submit letters to the editor of **The Nature of Illinois** at the address above.

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The Society Page

The third issue of the **The Nature of Illinois** comes to you from the Society for the Scientific Surveys to tell you more about what they are and do. Spring is a season of growth and development, and the work of the Surveys becomes most visible. Of course, the results are from the work the Surveys do year round, but we do become more aware of the natural resources surrounding us at this time of year.

The Natural History Survey in its work with the plants and animals of the state ensures that future generations will be able to enjoy a walk through the wilds, catching a glimpse of a red squirrel or a hawk. The Water Survey provides us with valuable information on unpredictable weather in the spring, allowing the agricultural community to plan ahead and warning the rest of us about unusual weather patterns that might develop. The Geological Survey aids the residents along the shoreline of Lake Michigan, helping them cope with and look for answers to the ravages of the rising lake levels which spring weather may aggravate.

In my opinion, the three Surveys are among Illinois' finest assets, not universally recognized, understood and appreciated for what they can do for our state in so many ways. Our Society's role is to bring them the visibility they deserve. Please support the Society and the Illinois Scientific Surveys in their work to enhance the wise use and management of the natural resources of our state.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

The Society for the Illinois Scientific Surveys

Scale of Contributions

Personal Memberships

Individual	$25 per year
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Contributing	100 per year
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A Tempest of Whirlwinds

Descriptions often vary. People who have seen one say it appeared as a massive cloud, dense as black smoke, with a deep roar like a freight train approaching. Others say it resembled a snake twisting out of the sky, writhing across the ground with hail and heavy rains pouring down. Some say the air became still, and the sky grew dark with an eerie green glow and brilliant lightning.

A tornado can be all of these things, or none of them. But one thing is for certain — it is a vicious natural phenomenon responsible for death and destruction.

Tornadoes result from a combination of the rapid lifting of warm air, coupled with the rapid rotation of air.

The Illinois Water Survey, as the state's primary weather research agency, investigates all severe weather phenomena related to thunderstorms and significant precipitation production. It has published information on tornadoes that is particularly useful now that tornado season is upon us.

It is estimated that 90 percent of the world's tornadoes occur in the United States with the maximum frequence

Twin twisters head northeast, away from Sidney, Illinois, and toward St. Joseph and Ogden on March 20, 1976. Photo by Frank Grussing of Sidney.

This is what remained of Alvin, Illinois' central business district following the March 16, 1942 tornado that swept a 60-mile path through east-central Illinois. Photo courtesy of Champaign County Historical Archives.

This car overturned near St. Joseph, Illinois. A 25-year-old woman and her two daughters, ages 2 and 4, were thrown from the car and killed by the March 16, 1942 tornado. Photo courtesy of Champaign County Historical Archives.

located in the central area. The factors which produce the high frequency of tornadoes in the central United States are the low-level tongue of moist air which penetrates into the heart of the continent, and the incursions of the jet stream over this low-level warm, moist tongue which cause vertical motion fields that modify an air mass to make it conditionally unstable. Tornadoes result from a combination of the rapid lifting of warm air, coupled with the rapid rotation of air.

There is considerable seasonal movement of the center of maximum tornado frequency in the United States. The center of maximum activity moves northward from the Gulf states in late winter, to Iowa in the summer, and then returns southward in the fall.

The seven states with a greater frequency of tornadoes than Illinois all lie west and southwest. Texas, Kansas and Oklahoma are the leading states of tornado activity, with Iowa, Nebraska, Missouri, and Arkansas leading Illinois. However, with 1,014 deaths in the 1916-1970 period, Illinois ranks first in deaths. Illinois ranks second in property loss and has 10 percent of all the tornadoes in the United States.

The state's high tornado rank is due to occasional, extremely large tornadoes, and the densest population of all the tornado states. If the statistics from the Tri-State tornado of 1925, the most devastating on record, were excluded, Illinois would rank eighth in deaths.

Tornado alley in Illinois (see map) represents an area of more frequent occurrences. The areas with the highest frequency are the southwest and west central to central part of the state.

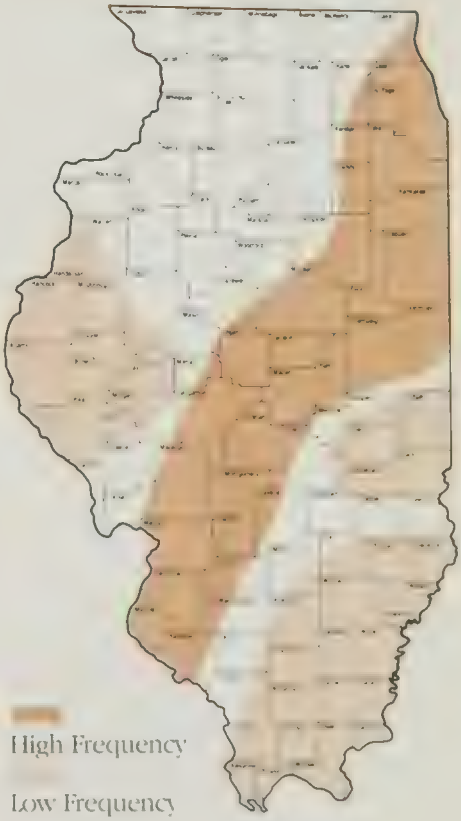
Prime season for tornadoes is March through May, when 62 percent have occurred. Narrowing it down even further, April is the most dangerous month, followed by May, March and June. The busiest week is April 15-21, claiming 9 percent of all Illinois tornadoes. Of all tornadoes, 50 percent occur between 3 and 7 p.m.

Illinois' tornado climate is significant because of the relatively high incidence of extremely severe tornadoes. Of 25 U.S. tornadoes that traveled 150 miles or more, 5 occurred in Illinois, with 20 of the 25 occurring east of the Mississippi River. The state has experienced the nation's two worst, longest-track tornadoes. One occurred on March 18, 1925 (the Tri-State tornado) and left 695 dead, 2,000 injured and $130,000,000 in losses. The second was the Mattoon-central Illinois tornado of May 26, 1917 which left 101 dead, 638 injured and $55,000,000 in losses. In recent times, a long-track tornado occurred on March 20, 1976 in central Illinois. It was 63 miles long traveling from five miles southeast of Decatur to five miles northwest of Danville. No one was killed, but 16 were injured and damages amounted to $5,000,000.

Even with these statistics before us, it is amazing to realize that very few people have actually seen a tornado. Those that have become uneasy as a storm approaches. Reading eyewitness accounts of those who have survived tornadoes makes it easy to understand nervousness during storms. The following is an eyewitness account from the worst tornado in history, the 1925 Tri-State tornado. Mrs. May Williams relates what it was like to be inside one of the buildings demolished by the tornado in Murphysboro in a letter to her mother. An evangelist in the "Whosoever Will" Mission in St. Louis, she had gone to Murphysboro for the day to help the Rev. and Mrs. Everett Parrott conduct a revival meeting at the Moose Hall:

> We left the Logan Hotel at about 2:25 p.m. and a goodly crowd was awaiting us in the Moose Hall. Mrs. Parrott opened the service singing 'More About Jesus'.
>
> She had sung the first verse and chorus, which we were repeating, when it grew dark as suddenly a thunderbolt flashed from the sky and there fell upon us what we thought was hail. But only for a moment. Then rocks began to break through the skylight above and in a moment's time we were being showered with glass, stones, sticks, old buckets, pans, trash, bricks and anything.
>
> At first, people were frenzied. The Methodist minister crawled under the front of the piano for protection and Brother Parrott under the back of the piano. Sister Parrott and I stuck together closely and somehow got out of the jam in which people were milling around. Mother, I wasn't afraid to die. Indeed, we all looked for it.

Areas of relative tornado frequency



> As I stood helpless looking up to heaven, I saw the concrete wall at the back of the hall collapse and come crumbling in. Then the roof started to give way and I closed my eyes.
>
> Suddenly, from the bottom of one of the stoves which heated the hall came a great puff and the flames burst out like tongues of fire

> There was the sound of an explosion, and the other stove was broken. The whole place rocked. From the outside as well as from within we could hear terrible cries, yells, screams and there were great popping noises.
>
> The wind roared — I cannot describe it — it tore great handfuls out of the roof above us. You could see the shapes hurling over us in the air. The only place in our building which wasn't damaged was the spot where Mrs. Parrott and I stood. Then the storm passed.

The Tri-State tornado began in southeastern Missouri and remained on the ground for 219 miles in passing across southern Illinois and into southwestern Indiana. It was extremely wide. Throughout most of the 86-mile track in Missouri the path was ¼ mile wide, but shortly after crossing into Illinois it widened to a mile and varied from a ½ mile to a mile in width across Illinois and on to Princeton, Indiana, a distance of 121 miles. The path then narrowed to ¼ mile until it dissipated. The total area of extreme damage amounted to 164 square miles across the three-state area. Its movement was also unique. It traveled in a straight path over much of the distance, and traveled at an extremely fast speed, the third highest on record. Contributing to the high number of deaths was the inability to see a funnel over much of the path. The tornado persisted for 3.5 hours, which is the longest duration on the ground on record and much longer than the average duration of tornadoes.

■

The state has experienced the nation's two worst, longest-track tornadoes. One occurred on March 18, 1925 (the Tri-State tornado) and left 695 dead, 2,000 injured and $130,000,000 in losses. The second was the Mattoon-central Illinois tornado of May 26, 1917 which left 101 dead, 638 injured and $55,000,000 in losses.

■

There is no doubt that the great loss of life in the Tri-State tornado of 1925 might have been reduced if highly developed communications networks had existed at the time.

It is argued that the threat of tornadoes in present day has been diminished because structural methods, particularly as used in modern homes, are substantially better than those employed 30 or more years ago. Without a doubt, forecasting technologies, communication systems (radio and TV), and remote detection of tornadoes (by radar) have improved greatly since 1950, and these should lead to a reduction of deaths and damages from tornadoes.

However with all the wonders of a modern age, the threat is still there because of our growing population, urban sprawl, and the inability to communicate tornado warnings to all. We are still as vulnerable to the massive, long-track tornado storm and widespread outbreaks of tornadoes as were the citizens of Illinois in 1925.

This article is based on information provided by the Illinois Water Survey: "Facts about Tornadoes", compiled by S.A. Changnon, Jr., and J.L. Vogel; "Illinois Tornadoes", by John W. Wilson and Stanley A. Changnon, Jr.; and "The Great Tornado", Illinois Magazine, March 1978, pg. 8-30. Wayne Wendland, State Climatologist, is currently compiling data on tornadoes from 1955-1986, which will be available to the public shortly.

Safety Precautions

1. Tornado Watch — This is an alert.

- Listen to radio or TV for further information.
- Plan where to go if a tornado is seen.
- Be prepared to act quickly.

2. Tornado Warning — Issued when tornadoes are sighted.

- If for your area, take safety precautions immediately — otherwise, continue to listen to radio or watch TV and watch the skies.
- Listen to NOAA weather radio, if one can be heard.
- Inform all family members.
- Be prepared with a radio with batteries and a working flashlight. Keep car keys on your person.

3. If a tornado is seen or reported near you, or a community warning system is sounded, do the following:

- Act quickly according to where you are.
- If you sight a tornado and time permits, call the Emergency Services and Disaster Agency (check phonebook) and/or the sheriff.
- Where to go depends on where you are. Always design a personal plan ahead of time.
- Always stay away from outer walls and windows of any structure, and use a storm cellar if available.
- If in a car, drive away at right angles after the direction is defined, or if uncertain, park and go into a sturdy building.
- If in open country, get in a ditch or depression.
- If in a house with a basement, go to the center of basement, and if possible get under a strong table or bench.
- If in a house without a basement, go to the center of the home and if possible get under a strong table or bench — or go to a closet, bath, or other small room.
- If in a house trailer, leave it. Go to a permanent sturdy shelter, or lie flat in a low-lying area, or if time permits, drive away. It is helpful to have a trailer park warning system.
- In large open space buildings such as auditoriums, gymnasiums, supermarkets, or malls with wide free span roofs, go quickly to designated shelters. If none, go to a nearby reinforced buiding, to closets, to stairwells, or restrooms.
- In a school, stay out of rooms and gymnasiums and go to central hallways.
- In office buildings, stay in an interior hallway on the lower floor, and preferably in the basement.
- Keeping windows open is a marginal help, but stay away from windows.

Picking Apples and Pears from the Right Family Tree

The Siberian Crabapple (Malus baccatta)

Bradford Pear (Pyrus Calleryana)

Are apples pears? It would hardly seem so. They have different textures and tastes, and their shapes are dissimilar. But dig a little deeper under their skins and there are many similarities. And, when pear and apple trees are in bloom, they look very much alike.

Scientists at the Illinois Natural History Survey are investigating the similarities and differences between apples and pears and many other species of plants that are classified in the same group.

Apples, pears, strawberries, raspberries, blackberries, cherries, plums, peaches and apricots are all similar examples of the Rose Family (Rosaceae). This family is broken down further into four subfamilies. Apples and pears belong to the subfamily Maloideae, characterized by a particular fruit type called a pome, with a thin skin covering a fleshy layer and a cartilaginous or a stony core. Also belonging to the subfamily Maloideae are hawthorns, cotoneasters, shadbushes, firethorns, mountain ashes, rowan trees, medular, loquats, chokeberries, Christmas berry and quinces. Botanists break the group down even further into genera and species. The Rose Family has approximately 100 genera and 3,000 species, and subfamily Maloideae about 23 genera and 1,000 species.

Dr. Kenneth Robertson, a Botanist at the Natural History Survey, says there is a great deal of controversy among botanists about what the limits of each genus in the subfamily should be, or in other words, what species should be assigned to what genera. Dr. Robertson and his postdoctoral assistant Dr. Joseph Rohrer, with Drs. James Phipps and Paul Smith of the University of Western Ontario, London, are in their third year of a study funded by the National Science Foundation to study this problem in light of today's knowledge, and how the genera are related to one another.

"The information gained in this study will be important to horticulturists, commercial nurserymen, systematists, and pomologists by providing a standardized classification system," Robertson said. "The subfamily Maloideae is of great economic importance."

The fleshy pomes of *Malus* (apples), *Pyrus* (pears), and *Cydonia* (quince), are major fruit crops. Fruit of several other genera reach limited markets, especially *Amelanchier* (shadbush, serviceberry), *Eriobotray* (loquat), *Mespilus* (medlar), *Chaenomeles* (Japanese quince), and *Crataegus* (hawthorn). Also, Maloideae includes a number of important woody ornamentals cultivated for their showy flowers and/or fruits with *Sorbus* (mountain ash), *Malus* (crabapple), *Pyrus* (pear), *Chaenomeles* (Japanese quince), *Pyracantha* (firethorn), *Crataegus* (hawthorn), *Aronia* (chokeberry), *Cotoneaster,* and *Photinia* being the more significant. In fact, almost all the species in Maloideae are decorative and cultivated to some extent. These plants are native to the North Temperate area of the earth, primarily in the United States, China and Europe.

"We want to develop a good classification system for this group of plants," Robertson said. "For example, should pears and apples be placed in the same genus? These determinations will be issued on a careful look at new information and on our own observations, not on other's work."

"After the information has been gathered we will define what species belong in what genera," Robertson said, "and then, determine the evolutionary relationships within the subfamily, or how the genera are related."

The team that is working on the project is definitely a qualified one. This research is a continuation of Dr. Robertson's work on the Rosaceae (Rose family) at the generic level and of his current investigations on fruits and seeds of the family. Dr. Phipps is a biosystematist who is studying the systematics and reproductive biology of *Crataegus* (hawthorn). Participating in the data analysis portion of the study is Dr. David Swofford of the Survey's Faunistics and Insect Identification Section. He is a leading developer of computer programs for evaluating evolutionary relationships.

Collecting the enormous amount of plant samples needed was the first step. Drs. Robertson and Phipps traveled to England to collect the majority of the samples. They returned with over 3,000 photographs, pressed plant specimens, and materials pickled in alcohol. A number of institutions were sources of plant material including The Hillier Arboretum in Hampshire; The Royal Botanic Garden, Kew; and The Royal Botanic Garden, Edinburg. In the United States, The Morton Arboretum, Lisle, Illinois; Arnold Arboretum of Harvard University at Jamaica Plain, Massachusetts; the Field Museum of Chicago; and the Missouri Botanical Gardens, St. Louis also assisted. A number of samples were collected in Mexico as well.

Analysis of the samples is now being conducted at the Natural History Survey in Champaign. The form and structure, or morphology, of the numerous species are being observed and noted. This is considered a crucial portion of the research since many of the differences in characteristics of the plants are subtle. Characteristics of the leaves, flowers and fruits are being examined.

Once these characteristics are recorded, data is entered into the computer, and the species are compared.

When pear and apple trees are in bloom, they look very much alike.

Now in the last year of the study, the majority of materials have been collected. Analysis of the flowers has been completed. The co-investigators in Canada have looked at the clusters of flowers and right now fruits and leaves are being examined.

"We have entered the flower data into the computer," Robertson said. "We will finish up the research this year, with the writing on our findings left to do."

The project is still in the information-gathering stage, but some generalizations concerning their findings are possible. Most of these preliminary findings are based on the flowers.

Are apples really pears? No, according to Dr. Robertson. "They are very similar but clearly belong to separate genera. It appears that apples are more closely related to *Docynia* (Chinese quince) and pears are more similar to the *Cydonia* (quince)." Other preliminary findings are that the genus *Sorbus,* which includes mountain ashes, will be split into five different genera. "Some species are more closely related to other genera," Robertson said. "For example, the genus *Aronia* and a species of *Sorbus* will probably be grouped together. Also, it is generally believed that Japanese quinces and quinces are closely related. We don't think they are."

Once the results of the study are published, it will be the first major worldwide systematic treatment of all genera of Maloideae since the late 1800's. Drs. Robertson and Phipps will be presenting papers at the International Botanical Congress in Berlin this coming July, and Dr. Rohrer will be presenting a paper to the American Institute of Biological Sciences at Ohio State University in August.

Dr. Kenneth R. Robertson is a Botanist and Professional Scientist in the Botany and Plant Pathology Section at the Illinois Natural History Survey, and holds an affiliate appointment with the Department of Plant Biology at the University of Illinois. He received his Bachelor's and Master's degrees in Botany from the University of Kansas, and his Doctorate from Washington University and the Missouri Botanical Gardens, St. Louis. Robertson has been with the Survey since 1976. Dr. Joseph R. Rohrer serves as a postdoctoral assistant. He received a Bachelor's degree in Biology from Davidson College in North Carolina, a Master's in Botany from the University of North Carolina and a Ph.D. from the University of Michigan in Botany. He is an Assistant Professional Scientist and has been with the Survey since 1986. Dr. David Swofford, Assistant Professional Scientist in the Faunistics and Insect Identification Section at the Survey, serves as consultant on the project. He received Bachelor's and Master's degrees in Biology from Eastern Kentucky University and his doctorate from the University of Illinois. He has been with the Survey since 1980.

In Danger

There are some 23 threatened and 58 endangered species of animals in Illinois: mammals, birds, fishes, salamanders, turtles, snakes, frogs, mussels and snails. There are 52 threatened and 312 endangered species of plants. At least 20 species of vertebrates have disappeared from Illinois since European man arrived here including the bison, elk, cougar, black bear, pine marten, fisher, timber wolf, red wolf, passenger pigeon, ivory-billed wood pecker, Carolina parakeet, Ohio lamprey, blackfin cisco, muskellunge, rosefin shiner, gilt darter, stargazing darter, and crystal darter. The latter seven species are fishes.

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Loss of suitable habitat, environmental contamination, and the inadvertent introduction of hardier rival species all have contributed to the eradication and endangerment of native Illinois flora and fauna.

There are now federal and state laws to protect endangered and threatened species. "Endangered" status is the more critical, meaning that the species is in danger of extinction. The "threatened" status is one step down from endangered, having the potential for becoming endangered. An endangered species in Illinois is "any species which is in danger of extinction as a breeding species in Illinois."

The Illinois Endangered Species Protection Board, appointed by the Governor and staffed through the Natural Heritage Division of the Illinois Department of Conservation, designates species as state-endangered or state-threatened. On occasion it also conducts research on certain species, using information supplied by the Natural History Survey (NHS) and other agencies.

Four threatened or endangered Illinois species are described below where they once lived, how they lived and why they may live no longer

The bobcat

Illinois Natural History Survey

The Bobcat *(Lynx rufus)*

Named the bobcat because of "its impudent and abbreviated tail," this member of the Lynx family is a threatened species in Illinois. Also known as the wildcat, it is now very rare and occurs in the wooded bottomlands of some of the major rivers throughout the state. It is found most frequently in the southern regions of Illinois. There are no good numbers on how many bobcats remain in Illinois, but in neighboring Missouri the cat numbers anywhere from 4,200 to 10,000 maximum. Dr. Glen Sanderson, head of NHS's Wildlife Research Section, guesses that Illinois has nowhere near this number.

The range of the species includes western North America from southern Canada to central Mexico; across the northern United States and southern Canada to Nova Scotia and the lower Appalachians; across the southern United States to sourthern South Carolina.

The bobcat is a short-tailed cat about twice the size of the average domestic cat, standing 20-23 inches high at the shoulder and weighing about 20 to 25 pounds. Its color is mostly yellowish-gray, with a sprinkling of black. The sides of the face support a ruff of cheek whiskers; the streaks on the long hair covering the cheeks are dark gray, and the upper tip of the tail is black. Each pointed ear bears a small tuft of hairs. Bobcat fur is dense, short and very soft. The bobcat is more muscular, more compact and better adapted for springing than the housecat.

Ideal hunting ground for the wildcat is broken country where the bobcat can feed on its usual diet of mice, rabbits, squirrels, birds and insects. The hunting territory of the cat can be very large. A bobcat den may be under a log, in a hollowed-out standing tree, or even in a thicket. Its young are born in March or April, and those young are usually only one litter of three every year. The development rate of the bobcat is very similar to that of the domestic cat, with the young leaving their mother in the late summer.

According to Dr. Sanderson, "Most people have a positive reaction to the bobcat, partly because it is such a beautiful animal and partly, I suppose, because so many people like cats."

This reaction persists despite the eerie and very loud series of yowls and meows the cat emits during mating season, leading people nearby to believe that a lion is in the vicinity.

The bobcat is a threatened species under state law and is protected from interstate shipment of illegal pelts under federal law. The season on bobcats is closed in Illinois, and various education and law enforcement programs aid in their survival. There are no bobcat management programs because the cat population is so scattered. While loss of habitat due to intensive agricultural practices is the main reason for its decline, the bobcat may have survived so far because it lives in so many habitats of varying sizes. Now the bobcat's most serious enemies are man and his dogs.

I'm optimistic that the bobcat will survive in Illinois," states Dr. Sanderson, "But I don't expect any big increases in population outside of the Shawnee National Forest."

The River Otter *(Lutra canadensis)*

A threatened species under Illinois state law, the river otter is a large elongate mammal with a broad flattened head, prominent whiskers, moderate eyes and small ears. It is a short-legged, thick-tailed aquatic cousin of the mink and the weasel. The otter is made for agility and speed in the water, with its streamlined body, webbed feet and long tapering tail. Its fur is mostly rich dark brown and serves as insulation for waters of all temperatures. About 43 inches long overall, it weighs about 20 pounds. The otter is relatively long-lived, living up to 19 years of age in captivity.

The visual sense of the river otter is not acute - it is nearsighted, all the better for underwater vision. However it can detect movement at considerable distances. Its auditory senses are well-developed. Otters make a variety of noises for communication - they chirp, growl, chuckle, grunt, snarl, whistle and scream.

The otter's favorite habitat is a large den never more than a few hundred yards from a stream or lake. The den entrance may be above or below water, protected by overhanging banks or large tree roots. Breeding occurs in winter, with a litter of three usually born 11 months later. The male stays in the vicinity of the den, although the female does not let him join the family until the young are old enough to travel. Adult females are devoted parents, teaching their young survival skills and fighting very aggressively for them when needed. At the third or fourth month, otter cubs must learn to swim. A family group may hunt and fish over a waterway of 10 or more miles during the season. Otters feed on fishes, crayfish, frogs, turtles, earthworms and aquatic insects.

Otters live in groups and are very sociable in contrast to their more solitary cousins, the weasel and mink. Otters love to build and play, and move at high rates of speed down homemade slides of clay or snow banks into water. A favorite activity is tossing something

The river otter

into the water and then retrieving it. The river otter can swim 1/4 mile under open water or ice and can remain submerged for 3 to 4 minutes. On the surface, the otter can swim at least 6 miles per hour. It is a highly intelligent, very curious, readily trained animal, able to make a game out of any occupation. Most of its active time is spent exploring new surroundings or objects, especially for play potential. One documented report has a river otter learning to retrieve waterfowl by watching a Labrador retriever perform.

There are now fewer than 100 river otters in all of Illinois. River otters were once fairly common along the large streams of Illinois, but by the early 1800's they were scarce in most parts of the state. Now river otters in Illinois may be found along the Mississippi River and along the lower reaches of the Illinois River. They have been around in these low numbers for at least 30-40 years.

The range of the species includes most of Canada, Alaska and the contiguous 48 states. Historically the biggest negative impact on the otter population came from fur trapping. Their natural enemies include dogs, bobcats, coyotes and foxes.

"The problems faced by Illinois' river otters now are the silting-in of streams, destruction of habitat and inadvertently being caught in fishermen's nets and steel traps set for other animals," according to Dr. Sanderson. "The Illinois Department of Conservation may decide to modify trapping and commercial fishing areas in certain areas where river otters can still be found. A further possibility is simply closing these areas to these activities. Since they have been present in the state for so long, even though in small numbers, I believe their chances for survival are good."

The eastern wood rat

The Eastern Woodrat *(Neotoma floridana)*

A state-endangered species, the eastern woodrat is a medium-sized rodent with large black eyes, prominent ears and a long tail. The upper parts of the woodrat are brownish-gray mixed with black, with its underparts white and a blackish-brown tail. The woodrat, also known as the pack rat and the trade rat, weighs in at 6 to 12 ounces.

According to Dr. Sanderson, most people are not afraid of this rodent, as they are of the Norway rat, probably because it is such a beautiful animal with a very soft pelt and very large eyes. It is also extremely shy of human beings.

The woodrat prefers timbered habitat in southern Illinois, inhabiting the cliffs and rocky bluffs overlooking the bottomlands of the Mississippi. It now exists in Illinois only in the Pine Hills of Union County, with a total population of only 25 to 35. As recently as 1973, the population was estimated at 50-75. The principal range of the species is in the southeastern quarter of the United States.

The woodrat builds nests in crevices or caves within these crevices and packs anything it can carry: bottle caps, belt buckles, buttons, gun cartridges, sticks, leaves, and the like. Most of these valuable items end up in its nest. If in its shopping spree it sees something it likes better, the woodrat will drop what it is carrying and pick up or "trade" for the new object. Campers may find they've received a pile of stones for their car keys, ammunition or what-have-you.

The woodrat is nocturnal, rarely coming out in daylight. It breeds in March, with a litter of 2-3 appearing in April. There may, however, be as many as 3 litters annually. Weaning occurs 4 weeks after birth. Woodrats are almost completely vegetarian, feeding on all types of plant food and fungi, but it sometimes eats snails and insects.

Their home range is small, 100 feet in diameter, and several woodrats may nest close together. They usually walk or run, are good climbers and very pugnacious. They often fight one another, rearing up on their hind legs and fighting with their front feet. Almost all carnivorous mammals living in woodrat country are enemies including hawks, owls, and snakes. They provide several benefits to the ecology: their nests are often used by other creatures, their droppings make good fertilizer and they are part of the foodchain for several other creatures.

"The outlook for survival of the woodrat in Illinois is questionable," Dr. Sanderson said. "We had a small population in Illinois to begin with, and now their habitats have been greatly altered by timber cutting and increased use of their range by humans. I am not optimistic, although there has been talk of re-introduction of the woodrat into some areas not currently inhabited by them."

The Bald Eagle *(Haliaeetus leucocephalus)*

The only North American representative of the fish or sea eagles, the bald eagle, is an endangered species in Illinois and is also a federally endangered species. The species range is the North American continent south to southern Florida and the coast of Baja California, Mexico. The bald eagle is also found on Bering Island, the Aleutian Islands and the islands off the coast of British Columbia and eastern Canada. The number of eagles has declined greatly

A mature bald eagle

Illinois Natural History Survey

since settlement of the continent by white men. That decline was greatly accelerated after World War II.

In Illinois, bald eagles historically have inhabited the major river systems of Illinois throughout the year, but now nesting of eagles in Illinois is a rare occurrence. They do still winter in the state, arriving from Minnesota and Canada and concentrating along the large rivers, the Illinois and Mississippi. Regular surveys of eagle populations are conducted by NHS personnel in 11 Illinois regions. Four of those regions - the central and southern lakes, northeast lakes, strip mines and lower Kaskaskia River - had relatively few numbers of eagles. There were seven regions where significant numbers were seen: the northwest Mississippi river, the upper and lower Mississippi, the southern Mississippi, and the northeast, upper, and lower sections of the Illinois river.

The bald eagle is brownish-black except for the head and tail which are snowy white, and the bill, eye and feet which are bright yellow. It has a wingspan of 6 to 7½ feet. Its vocalizations comprise mostly squeaky cackling, very close to that of a gull's.

The eagle soars impressively or sits on a commanding perch along the shore. It has two perches, really. One is a night roost, where the eagle rests after sunset, in an area usually well-protected from the wind. Its diurnal perch is almost always near open water, usually dams in Illinois, which allows easy feeding on fish and waterfowl. The eagle may hunt its prey in pairs, to tire out and catch a wounded or weak flying waterfowl, or even drag a large floating fish to shore.

A pair of eagles will remain together at nesting season as long as both are alive, and engage in various courtship flights including a spectacular locking of talons in mid-air and descending for several hundred feet in a series of somersaults. Its nest is found in a large tree or rocky promontory. It is generally a large structure of sticks lined with softer material. Nests are added to year after year until the tree dies. Two eggs are normally laid, plain dull white with a rough shell. Incubation lasts about 35 days, with the young eagles staying in the nest for 10 or 11 weeks. After the eggs hatch, there may be severe antagonism between the two siblings, and sometimes the weaker is killed or starves.

The leading causes of mortality among bald eagles in Illinois were loss of suitable habitat, illegal shooting, chemical contamination and reduced reproduction due to environmental contamination. Now protected by the federal Bald Eagle Protection Act, the Migratory Bird Treaty Act and the Endangered Species Act of 1973, the eagle faces several obstacles to survival, including illegal shooting, loss of forest bottomland, and disturbance of nesting and roosting by humans.

The Natural History Survey conducts aerial surveys and counts of bald eagles on a regular basis. NHS inventories in five Illinois regions show that the central Mississippi River supported the highest average number of eagles counted per weekly or biweekly census period, with peak average values between 318-369. Comparable values for other regions inventories were: 200-204 for the Illinois River; 139-149 for the northern Mississippi; 76-78 for the southern Mississippi,and 21-24 for northeastern Illinois. Wintering eagles appear in October, with the eagles departing Illinois by mid-April. The number of eagles now appearing each fall and winter in southern Illinois has increased greatly since the period 1949-1970, and they may be re-establishing a population in the Mississippi River valley similar to its historic pattern. One to three nesting pairs have been recorded in southern Illinois since the mid-70's.

The resurgence in bald eagle populations is due in good part to planned events associated with refuge development and management, good publicity and increased law enforcement efforts. The Nature Conservancy, the Audubon Society, the Wildlife Federation and the Illinois Department of Conservation, along with the NHS, have all been active in the fight to keep the bald eagle a part of Illinois' natural heritage.

Dr. Glen Sanderson is head of the Natural History Survey's Wildlife Research section and a member of the Endangered Species Technical Advisory Committee for Mammals, which serves as an advisory body to the Illinois Endangered Species Protection Board.

The Hidden Landscape

In Illinois 315 million years ago, the air was damp, foggy and misty. Lands were swampy, with low lying woodlands. Shallow seas encroached onto the deltas, creating estuaries, while insects and dragonflies flitted to and fro. Amphibians and early reptiles roamed the lands and waters, and primitive fish swam in the seas.

It was what scientists would later label the Pennsylvanian Period of the Paleozoic Era, or the "Era of Ancient Life", when coal was deposited in great swamps. Amphibians and reptiles became good-sized and common by the end of the Pennsylvanian Period.

In November of 1985 Joe Devera, an Assistant Geologist with the Illinois Geological Survey, was conducting business as usual working in the field on the Survey's and U.S. Geological Survey's joint quadrangle mapping program. Devera, while traversing up a ravine northeast of Eddyville in southern Illinois, saw black shale exposed. "This was interesting," Devera said. "Most of the strata in the area is sandstone. Black shale sometimes indicates marine environments. I wondered if this was shale marine."

Devera picked through the shale and excavated it, breaking away the matrix to expose the organisms. "When I saw it I started jumping up and down," Devera said. "I knew immediately it was a marine fossil of a goniatite cephalopod and there was a good diversity of them." Devera had found 350 marine organisms in shale from the lower Pennsylvania Period.

It is doubtful that those little organisms, which lived in anonymity 315 million years before, realized what a hit the discovery of their remains would be in 1985.

A find such as Devera's is one of the joys of paleontology, the science of past plants and animals based upon fossil evidence. Fossils help geologists figure the ages of rock strata and the relative times at which animals and plants lived. Fossils also are clues to changes that have taken place on Earth. For example, paleontologists sometimes find fossil seashells in strata high in a mountain, far from an ocean. These discoveries indicate that the strata formed a muddy ocean bottom long before the rocks were lifted to form a mountain.

The black shale that Devera discovered contained a diverse marine fauna of four different genera and five distinct species of ammonoid cephalopods - goniatites, or coiled creatures that are distant relations of the present-day chambered nautilus.

Devera said the fossils were primarily juveniles. "It is thought that this area was a 'nursery', or protected environment for the young cephalopods. Since the estuary was low in oxygen, as seen from the shale color and marcasite replacement, this would have provided a rough environment for anything else to survive."

Devera picked through the shale and excavated it, breaking away the matrix to expose the organisms . . . Devera had found 350 marine organisms in shale from the lower Pennsylvanian Period.

Cephalopod fossils have been found in rocks of many ages, and numerous representatives are alive today. Squids, octopuses, cuttlefish and the pearly nautilus are among the cephalopods living in modern seas.

Cephalopods are one of the most advanced groups of animals without backbones. They have a highly developed nervous system and eyes much like those of humans. The cephalopod's mouth is surrounded by long tentacles commonly armed with suckers. Beneath the tentacles is a tube through which the animal can force a jet of water and move about by jet propulsion.

Coiled cephalopods live today only in the South Pacific, but in the geologic past they were scattered throughout the world. Modern squids live in shallow coastal waters over much of the globe.

What was most important about Devera's find was the discovery of the *Axinolobus* type of cephalopod, which had never been found in Illinois or the Illinois Basin, a broad geologic structure that contains 25,000 feet of sedimentary rocks in Illinois, parts of Indiana and western Kentucky.

"The lower Pennsylvanian strata was typically thought to be primarily land, but these organisms are only found in seas, so there is more marine influence in this area than previously thought," Devera said.

Since *Axinolobus* had been found in Arkansas, its discovery in Illinois extends the geographic range of the organism, correlating Illinois and Arkansas strata. Discovering organisms such as the *Axinolobus* allows geologists to zero in on specific times so narrower limits or intervals of time can be tied to the rocks.

"By establishing that there is marine strata in the Eddyville area south of

Harrisburg in Pope County, it's possible to deduce that there won't be any well-developed coal found locally, or if there is, it will be high in sulfur because of the salt water influence during deposition of the coal content," Devera said.

That is the key use of paleontology in the Cooperative Geologic Mapping Program (COGEOMAP) in southern Illinois. By determining the age of the rocks and the type, much can be learned about coal and oil resources and reserves.

The southern Illinois area was selected for the mapping program because it contains the southern margin of the Illinois Basin and is rich in mineral resources. The coal-bearing rocks deposited during the Pennsylvanian Period are well-exposed in this area and the older parts of these rocks are a target of the mapping program.

Efforts by Geological Survey mappers have located seams of low to medium sulfur, high-heating value coals.

Axinolobus as it appears in the Arkansas strata.

Gastriosceras - also a distant relation of the present-day chambered nautilus.

> **"The lower Pennsylvanian strata was typically thought to be primarily land, but these organisms are only found in seas, so there is more marine influence in this area than previously thought."**

Although generally thinner and less easily mined than other Illinois coals, these seams will increase estimated resources of coal in Illinois when their full extent and occurrence have been mapped. Detailed mapping also is changing geologic concepts of the region in ways that could provide new tools for successful oil and gas exploration. Faults that parallel the trend of mineralized faults in the Illinois Fluorspar Mining District have been located west of the previously interpreted edge of the District. If these faults also are mineralized, U.S. fluorspar resources might be increased substantially.

At completion in 1990, the COGEOMAP program will have produced 15 7.5-minute quadrangle maps, provided models for environments of deposition, and identified quantity and quality of coal resources, geologic/tetonic structure, mineral occurrences, (fluorspar, lead, zinc, rocks, sand, gravel, and clay), and geologic hazards (unstable materials and faults).

The paleontologists at the Geological Survey are not unlike private investigators. Both gather evidence to determine what actually happened at a specific time and place. The difference is private eyes have fresh clues to follow. Paleontologists' clues are millions of years old.

Joe Devera is an Assistant Geologist II at the Illinois Geological Survey. He has spent his two years at the Survey with the COGEOMAP program. Joe received his Bachelor's degree in Geology at Northern Illinois University at DeKalb, and his Master's degree in Geology at Southern Illinois University at Carbondale. He will be reporting his Axinolobus findings to the scientific community at an upcoming conference at the University of Minnesota at St. Paul.

Hazardous Waste in Your "Home Sweet Home"

Very few of us have spent much time thinking about the quantity of poisons and hazardous materials we have stored in our homes. However many of the products we use and store there are classified as household hazardous waste. Oven cleaners, drain and toilet bowl cleaners, garden herbicides, insecticides, motor oil, antifreeze — the list goes on and on. All of these materials can be hazardous to you and the environment if they are not used and disposed of properly.

To many, hazardous waste means Love Canal and barrels of DDT leaking into streams. Yes, these do represent a major portion of the hazardous waste problem. However, household hazardous waste may not be a minor part of the overall problem, as many think it is, according to Dr. David Thomas, Director of the Hazardous Waste Research and Information Center (HWRIC). "The problem is largely undocumented since households fall in an unregulated area along with other generators of very small quantities of hazardous wastes such as school laboratories, some hospitals, some small businesses and farms. Since these hazardous materials are disposed of with ordinary household garbage, they end up in the municipal landfills, which are not designed for hazardous wastes." A possible result is leaching into groundwater supplies.

The federal government defines hazardous waste as a waste that is:

1) Ignitable (flash point less than 140°F.)
2) Corrosive (pH less than 2 or greater than 12.5)
3) Reactive (explosives, unstable compounds, compounds that react with water), or
4) EP Toxic (wastes that contaminate groundwater)

HWRIC favors a broad definition of household hazardous waste, which reads: "Household hazardous waste is any substance that poses a threat to human health and the environment when improperly handled or disposed of."

Some materials considered hazardous by HWRIC do not appear on the federal government's list of hazardous wastes, such as antifreeze, asbestos (shingles, piping insulation, brake linings in cars), some pesticides, and used motor oil.

"Household hazardous waste by definition is excluded from regulation," added Dan Kraybill, Industrial Assistance Engineer at HWRIC. "It can legally be thrown in the trash."

Dangers to Humans

"There are dangers in just having these materials around the house," Kraybill said. "Most toxic cleaning agents give off fumes, and many materials are explosive and can burn. Storing them properly is very important. For example, antifreeze has a very sweet taste, but is extremely poisonous. If it is left out, small children or pets may get into it resulting in a real tragedy."

The nature of some household hazardous wastes also increases their potential damage to homeowners over a period of time. Materials that are used infrequently are often stored in closets, basements, or garages for long periods. Products such as paint thinners, solvents, fertilizers, and others may corrode containers over the years, causing the containers to deteriorate. This further increases the potential danger to homeowners.

"When homeowners use hazardous substances they need to be wary," Kraybill said. "Most products carry warnings, such as 'use in a well-ventilated area' or 'wear protective gloves when using', but most people don't read the directions."

The average person doesn't think of refuse collection as being a dangerous occupation, but people who collect refuse are also affected by household hazardous waste. For example, half-empty aerosol cans containing certain materials can start fires in packer trucks when crushed.

A number of injuries are reported in the U.S. Environmental Protection Agency's (EPA) report on household hazardous wastes:

- Swimming pool chemicals splashed on a collection worker resulting in the loss of 50 percent of the use of his left eye.
- Used motor oil caused severe eye irritation of three disposal personnel.
- At least three injuries caused by exploding aerosol cans occur per month in San Francisco.
- A sealed container of ammonia burst under compaction and sprayed a refuse collector's eyes and face in Michigan.

Most of these injuries occurred while waste was being emptied or compacted. Personnel at transfer stations, landfills, or other disposal sites may also be injured by household hazardous waste. The activities of unloading, spreading, and compacting refuse often cause containers to rupture and contents to be sprayed into the air. Some examples include:

- A collecton vehicle caught fire and was destroyed in Michigan.
- A resource recovery facility was severely damaged by a fire from a small container of flammable material in Wisconsin.
- Three persons were hospitalized with rashes and respiratory problems at a transfer station in Lexington, Kentucky.
- In Downers Grove, Illinois, chlorine tablets caused a fire in a truck.

The Effect on the Environment

What are the dangers once the materials are in the municipal landfill? According to the U.S. EPA study, indirect evidence indicates that household hazardous waste may contribute to groundwater contamination. More than 12 former municipal waste disposal sites are on the Superfund list of sites requiring corrective action. In the past, these sites received household hazardous waste and commercial/industrial wastes in addition to household refuse. The present groundwater contamination indicates that industrial or house hold hazardous waste chemicals are the source of the problem. However, no direct proof exists that household hazardous wastes are the *only* pollutants.

"Solvents can leach out of a landfill," Kraybill said. "Even the lining at a landfill can be damaged, and a hole no bigger than the size of a fist is a real problem."

As the evidence indicates, there appears to be an effect on human health and the environment from household hazardous waste. It starts with the homeowner and continues through the refuse collector and disposer. And, after disposal in a landfill environment, household hazardous wastes can contribute to contamination of air, subsurface gas, groundwater and surface water.

What to Do?

What can we do about the hazardous household materials we have in our homes? "Well, the best solution is not to get into a disposal situation," Kraybill said. "By that I mean use up the materials completely. If you can get by without them, don't buy them again, or only buy in small quantities. Also, there are many alternatives available that aren't hazardous." (See chart).

It is estimated that every month Chicago residents (3 million in the 1980 census) dump 120 tons of toilet bowl cleaner into the sewers, pour 440 tons of liquid household cleaners down the drain, and dispose of 1100 tons of recyclable motor oil.

It is estimated that every month Chicago residents (3 million in the 1980 census) dump 120 tons of toilet bowl cleaner into the sewers, pour 440 tons of liquid household cleaners down the drain, and dispose of 1100 tons of recyclable motor oil. Buying and using less hazardous products can help eliminate this source of environmental pollution in general.

To deal with the problems of household hazardous wastes, over 530 collection events have been held in 33 states.

A major goal of these collection programs is public education of the dangers of household hazardous waste. The programs focus on the following activities: making the public aware of the presence of hazardous materials in the home and consequences of improper use and disposal; identifying substitutes that are less hazardous; encouraging better home management practices, such as buying only what you need; identifying proper storage and disposal methods; and promoting participation in household hazardous waste collection and recycling programs.

Most locally run programs use the collection site approach. Participants are asked to haul their household hazardous waste to a collection site for centralized identification, packaging, and shipment to a permitted hazardous waste facility. The state programs active now in Vermont, Connecticut, Florida, Michigan and Rhode Island basically consist of grants to local collection efforts and state-operated collection programs.

"We are really just getting started in Illinois," Thomas said. "The League of Women Voters, which is probably the most active organization across the country in this type of collection program, local health officials, and a number of other interested parties and the HWRIC, have held several meetings to discuss the issue. As a result, we are attempting to start a pilot program in Champaign/Urbana in conjunction with the local Solid Waste Group."

If you would like more information about household hazardous waste or about what your community can do to establish a collection program, contact Christina Komadina, HWRIC Information Services Coordinator, (217) 333-8956.

Dr. David Thomas joined the Hazardous Waste Research and Information Center in Champaign as Director in May, 1985. He received his Bachelor's and Master's degrees in Ecology from the University of Illinois and his Doctorate in Ecology from Cornell University. Prior to his appointment at HWRIC, he worked for a private consulting firm performing environmental studies. Dan Kraybill is the Industrial Assistance Engineer with the Industrial and Technical Assistance Program at HWRIC. He has Bachelor's and Master's degrees in engineering from the University of Illinois and is a registered professional engineer. He has worked in environ mental control for over 10 years. Christina Komadina, HWRIC Information Services Coordinator, has been instrumental in gathering information concerning household hazardous wastes and on work done in other states, and in coordinating collection program efforts. HWRIC is an administrative unit of the Illinois Water Survey.

Household Hazardous Waste Family Reference Chart

Substance		Problem	Proper Disposal	Alternative
Pesticides Herbicides	Rodent Bait	Lethal to humans and pets in minute quantities.	Use up according to directions or take to hazardous waste collection site.	Cats; traps; chopped bay leaves and cucumber skins
	Insect Repellent	Poisonous.	Use up according to directions or take to hazardous waste collection site.	Screens; protective clothing; or use creams or lotions.
	Garden Herbicides, Insecticides, Fungicides, etc.	Poisonous. Can persist in the environment. Especially hazardous around food plants.	Use up according to directions or take to hazardous waste collection site.	Strong hosing or handpicking; keep garden clean; use 'natural' insecticides like rotenone; or predators like ladybugs/praying mantises.
Home Personal Products	Drain Cleaner	Poisonous and capable of causing serious burns.	Wash down drain with lots of water.	Boiling water; plunger; metal snake
	Oven Cleaner	Poisonous and capable of causing serious burns.	Use up according to directions or take to hazardous waste collection site.	Baking soda and water; salt; quarter cup of ammonia overnight.
	Toilet Cleaner	Poisonous and capable of causing serious burns.	Wash down drain with lots of water.	Baking soda; mild detergent; *or* small amounts of bleach.
	Spot Removers	Most are solvent-based (in other words, they contain strong chemical dissolvers) and are poisonous.	Use up according to directions or take to hazardous waste collection site.	Club soda; immediate cold water; corn meal and water soak; lemon juice.
	Silver Polishes	Poisonous.	Use up according to directions or take to hazardous waste collection site.	Soak silver in water with baking soda, salt, and small piece of aluminum foil.
	Furniture Polishes	Include various poisonous solvents.	Use up according to directions or take to hazardous waste collection site.	Mineral oil with lemon oil or Carnauba wax.
	Powder Cleaners/ Cleansers	Strong oxidizers, poisonous, can cause burns.	Wrap in plastic, place in a box, and put in garbage.	Baking soda and mild detergent; elbow grease.
	Window Cleaners	Harmful chemical compounds.	Wrap in plastic, place in a box, and put in garbage.	Rub windows with newspapers; vinegar and water.
	Mothballs	Poisonous chemical compounds.	Use up according to directions or take to hazardous waste collection site.	Cedar chips; newspapers.
	Bleach and Liquid Cleaners	Strong oxidizers - can cause burns.	Wash down drain with lots of water.	Use powder, not liquid bleach.
	Dyes	Poisonous, espcially with kids; don't use cooking utensils when dyeing.	Wrap in plastic, place in box, and put in garbage.	Use vegetable dyes; onion skins, teas, marigolds.
	Outdated Medicines	Hazardous to others in family.	Wash down drain with lots of water.	None
Automotive Paint Products	Motor Oil	Poisonous chemical compounds, as well as lead and other metals.	Take to service station or local waste oil recycling center.	None.
	Transmission/Brake Fluid	Poisonous chemical compounds.	Take to service station or local waste oil recycling center.	None
	Antifreeze	Sweet-tasting and poisonous, don't leave puddles where kids or pets can get to them.	Wash down drain with lots of water.	None.
	Car Batteries	Highly acidic (can produce serious burns) and contain lead.	Trade in or take to special recycling center (See telephone book).	None
	Paint*	Solvents and other poisonous chemical compounds.	Let evaporate, then wrap residue and place in garbage.	None; use water-based (latex) if possible; avoid aerosol sprays
	Laquer/Varnish Thinner/Stripper/ Turpentine	Solvent-based, some flammable, all poisonous.	Use up according to directions or take to hazardous waste collection site.	None

*Old, lead-based paints are toxic and should not be used. Take them to a hazardous waste collection program (or store until one is available).

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SURVEYING ILLINOIS

GEOGRAMS

Field trips coming

Comfortable clothing, walking shoes, bag lunch and transportation are necessities for geological science field trips scheduled this spring. Designed to acquaint participants with the geology and mineral resources of Illinois, these 8:15 a.m. to 4 p.m. outings will be held at Tunnel Hill in Johnson County, April 25 and at Dallas City, Hancock County, May 16.

David L. Reinertsen, Senior Staff Geologist and head of the Illinois Geological Survey's Educational Extension Unit, notes the trips will begin immediately following registration at designated starting points. At Tunnel Hill, participants will register at New Simpson Hill Elementary School, the intersection of U.S. 45 and County Highway 12. Dallas City High School, 203 East 4th Street, will be the embarking point on May 16.

Open to everyone, these free expeditions provide frequent stops for exploration, discussion and collection of rocks and fossils and are especially helpful to teachers planning earth science, geography and history units. Drivers should begin the tour with a full tank of fuel. To ensure safe travel on some roads and bridges, school buses are limited to a 12,000-pound capacity. Although everyone is welcome, a responsible adult must accompany each grade school student, and an adult supervisor must be present for every 10 high school students.

For additional information about these field trips or a tentative fall schedule, contact the Illinois Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, Illinois 61820, 217/344-1481.

Loop connection

Joining occupants of the new State of Illinois Building, 100 West Randolph Street, Suite 11-600, Chicago, last summer was the Illinois Geological Survey (IGS). In this downtown location, the Survey has re-established a regional office in northeastern Illinois with a staff of two: William G. Dixon, Jr., Staff Geologist, and Terrie P. Adams, Assistant Staff Geologist.

Besides offering public information and a reference library of survey publications, the staff is supplying geologic information to and collecting geologic data from drillers, large construction companies, mineral industries, geotechnical firms, and waste disposal firms, as well as state and local governmental agencies.

Another major thrust for them is providing liaison and publicity for the Superconducting Super Collider (SSC), which Illinois is vying for in national competition, and hopes to build adjacent to Fermi National Accelerator Laboratory in Batavia. Toward this end, Dixon and Adams are establishing and maintaining contacts with local governments, maintaining close association with field exploration programs, serving as a source of technical information on the SSC and interacting with SSC for Illinois, Inc.

Satellite maps of the state and northeastern Illinois, priced at $4 each, are currently sold at that location. The office also offers visitors a list of IGS publications from which they can order.

Research Project Focuses on Subsidence

IGS engineering geologists are taking a lead role in a multi-year research program to investigate the effects of coal mine subsidence on prime Illinois farmland. The aim of the program is to develop guidelines for underground mining that will promote maximum coal recovery while minimizing or eliminating crop damage on land above the mines.

The research is sponsored by the Illinois Coal Development Board and the U.S. Bureau of Mines. Paul DuMontelle, Head of the Earth Hazards and Engineering Geology Section, is the director of the Illinois Mine Subsidence Research Program. Robert A. Bauer, Head of the IGS Rock Mechanics Laboratory, is technical manager. Other participants are from the University of Illinois, Southern Illinois University, and Illinois Department of Mines and Minerals.

In a current project, monitoring equipment has been installed at a site over an active high-extraction retreat mine in Williamson County where subsidence will occur as part of the mine plan. Characteristics of the materials over the mine, mine floors, and soils and crops are being studied.

BIORHYTHMS

Illinois Welcomes the Grass Carp

Late last year the Illinois Department of Conservation (IDOC) made importation of the sterile triploid grass carp legal. The grass carp is used in lakes to control nuisance vegetation. All strains of the carp had been banned because of fears that the fish would reproduce in the country's big rivers and destroy natural wetlands. Based on research done by Natural History Survey (NHS) scientists Drs. Wiley, Philipp, Gorden and Tazik, a sterile genetic strain was identified and legalization of that strain's importation quickly followed. This year is the first year the grass carp can be used in Illinois to control aquatic vegetation.

The Rose Family

Spring is here and with it a wide variety of plants are bursting into blossom. A number of these flowers belong to a botanical group called the Rose Family *(Rosaceae)*. Dr. Kenneth R. Robertson of the NHS has been studying this plant family for a number of years. According to Dr. Robertson, the woods in many parts of Illinois will be dotted with the lovely small trees known as shadbushes, along with wild crabapples, hawthorns, plums and cherries. A wide variety of other spring flowers belong to the Rose Family, both in the wild and in cultivation, such as spireas, cinquefoils, blackberries, brambles, strawberries, avens, ninebarks and of course roses.

Most people are familiar with the large, beautifully shaped and fragrant flowers of hybrid tea roses, but are unaware that six different kinds of roses occur in Illinois. And incidentally, are roses really red? No wild species of the entire Rose Family has red (or blue) flowers, lacking the ability to produce such pigments. However, a mutation occurred in some cultivated roses where a true red pigment was produced. The first hybrid tea rose containing this pigment was introduced in 1951.

Indiana Bats Are Illinois Bats, Too

The federally endangered species known popularly as the Indiana Bat dwells during the winter in well-protected cave habitats. In the springtime, the bats establish maternity or nursery colonies in trees along rivers and creeks throughout Illinois. Only one such colony has ever been found in Illinois until now. Mr. Gene Gardner and Dr. Joyce Hofmann of the NHS and Mr. Jim Garner of IDOC spent two years surveying 850 trees with the help of bat detectors using ultrasonic sound. One such nursery colony was found in Pike County, Illinois. The next step for the researchers was to attach a transmitter to a female bat. Tracking that bat led to discovery of a second colony in September of 1986, where at least 10 juveniles were found. A maternity colony can include as many as fifty female bats. A paper on the scientists' findings will be presented to the Illinois State Academy of Science in April of 1987. An article on their research will be published in 1988 in the Proceedings of the Academy.

The Bald Eagle and Artificial Perch Trees

Naturally the bald eagle has never had a large population nesting in Illinois. The birds do winter in Illinois, but they are migratory and the ones who do winter in Illinois generally come from northern Wisconsin, Minnesota and parts of Canada. The eagles favor very large, tall, sturdy trees with open-growth forms that make perches easily accessible. Among Illinois trees favored by the bald eagle are floodplain cottonwoods, sycamores and silver maples.

Because of construction work done by the Illinois Department of Transportation (IDOT), a new perch tree is now being experimented with. When IDOT put in a new bridge at Hamilton, Illinois and Keokuk, Iowa, several preferred perch trees for bald eagles were destroyed. To mitigate the damage caused by the bridge, IDOT worked with the Illinois Department of Conservation to construct artificial perches. From November, 1986 to March,1987, NHS scientists Patti Malmborg and Glendy Vanderah monitored the effectiveness of the perches. The first year, with two artificial perches constructed, was a bad year for large concentrations of eagles due to warm temperatures and open water. But even under those conditions, one adult eagle used one of the perches.

Four more perches were added, this time resurrecting dead trees and planting them in the banks of the Mississippi River. This new concept and branches laid against the two telephone pole perches - both designed by Dr. Thomas Dunstan of Western Illinois University - proved successful as several more eagles were seen to use the perches in the second year of the study.

Fishing Along the Illinois Shoreline of Lake Michigan

Many Chicago residents may remember the overpowering smell of beached alewives emanating from the shores of Lake Michigan during the 1970's. Alewife abundance is markedly down since then, but there is now concern that Lake Michigan salmon (which feed on alewives) have decimated the alewife population. The alewife population may be under control, but the growth rate of salmon is not.

The bright side of the picture is that a dramatic resurgence in yellow perch is associated with the decline in alewives. This may be because the declining alewives are not eating the newly hatched perch. Perch are now quite abundant, with Illinois sports fishermen catching one million per year in the Illinois waters of Lake Michigan.

NHS scientists, headed by Dr. William Horns, are involved in three Lake Michigan fishing studies. The first is a creel survey, which allows the researchers to get a fix on fish that have been stocked in the lake. The second study - showing that yellow perch may not be growing as fast and as big as they should - is a collaborative effort involving scientists in Wisconsin, Indiana and Michigan. The third study's focus is on lake trout reproduction in the area known as Julian's Reef, twelve to fourteen miles east of Fort Sheridan. This is the area where since 1980 all of the lake trout stocked by the state of Illinois have been put. NHS scientists see cause for optimism in studies that show the trout may be spawning as they should and may have staying power.

Des Plaines Wetlands to be Re-Created

The Des Plaines River north of Chicago was once known for its deep and shady pools used for fishing, bathing and swimming. The area was a natural wooded wetlands. Now oily substances and trash can be seen floating on the river's surface. The waters are loaded with sediment and support only rough fish, while the river banks are covered with silt.

The Des Plaines River Wetlands Project is an attempt to restore a 2.8 mile section of the upper portion of the river to a natural wetlands state, while providing a living laboratory for scientists. The Illinois Water Survey (IWS) will provide the hydrologic data used by other disciplines in their projects. Information on hydraulics, rainfall, evaporation, temperature and other criteria will be used to determine how a habitat responds to imposed conditions. Basic data collection by IWS is the order of the day. Collection of suspended sediment and water quality data has been ongoing since July, 1986. A baseline survey and analysis of the hydrology, water quality and climatology of the area has already been completed by IWS researchers.

Differences in Water Quality Can Affect Toxicity

Water quality standards are often set at the same level for all types of water. But the toxicity of a substance may differ greatly depending on water characteristics. This has important ramifications for establishing water quality criteria for specific toxicants. Wuncheng Wang, an IWS researcher doing work for the U.S. Environmental Protection Agency, demonstrated the need for different criteria for different sites.

Wang's study was designed to determine how toxic barium, chromium and nickel would be to duckweed plants in water from 18 different water bodies in Illinois and neighboring states. Results varied markedly depending on the water quality of the test samples used. Wang's findings include a recommendation that researchers measure the way test organisms respond to a universal reference toxicant in conducting biological toxicity tests. No substance has yet been accepted as a universal reference toxicant, but the IWS researcher's study indicates that chromium, the substance least affected by the water quality of test samples, may be the universal reference toxicant for which scientists have been looking.

Shrinking Water Supplies

IWS researchers plan to estimate the year in which 102 surface water supply systems in central and southern Illinois might become deficient due to future droughts. Mitigation measures will then be identified to make the systems adequate for the next 15-20 years. The research is funded by the Division of Water Resources of the Illinois Department of Transportation.

For each of three years - 1995, 2005, and 2015 - IWS researchers Krishan Singh and Michael Terstriep will use a computer program to compute what the reservoir yield for each of the 102 systems would be under four different drought scenarios. The 102 surface water supply systems to be studied serve about 250 small- to medium-sized towns. Already some of the systems to be studied have difficulty supplying enough water during years that are only moderately dry.

Speed Reading in the Laboratory

A new instrument in the IWS's Analytical Chemistry laboratory can detect as many as 40 elements in a water sample and print out the results in about 2 to 3 minutes. The instrument - an inductively coupled plasma (ICP) spectrometer - began operation in March and will enable IWS laboratory workers to do five times the number of sample determinations in a day than was previously possible.

The ICP spectrometer was purchased with Build Illinois funds, and under the terms of the purchase agreement will be shared among the Water, Geological and Natural History Surveys.

Low-Lying Areas Face High River Flows

Illinois farmers in low-lying areas along the Illinois and Mississippi Rivers are facing increasingly severe problems because of high river flows. Flood peaks, flooding frequency and the duration of high flows along these rivers have increased in recent years. Some farmlands are protected from flooding by levees, but groundwater levels also increase, forcing farmers in levee areas to pay high power costs to pump the excess groundwater out of their fields.

A new IWS study focuses on these high river flows and their impact on agriculture. The research project will examine how the magnitude and duration of high flows in the Illinois and Mississippi Rivers have increased over the past 40 years; how these trends are affecting farming economics; when high river flows will make farming in these areas no longer profitable; and what remedial measures might be taken.

Gettysburg Monuments Endangered by Pollutants

One of the greatest battles ever fought on the North American continent was fought during the Civil War at Gettysburg, Pennsylvania. To honor the soldiers who fought there, bronze, marble and granite memorials, statues and plaques were erected and are viewed by over a million visitors every year. Many of the monuments show signs of surface disfigurement and corrosion caused by natural weathering, possibly accelerated by acid rain and dry deposition of sulfur dioxide and nitric acid vapors.

IWS researchers are studying air and precipitation chemistry and its relationship to monument deterioration at Gettysburg. The study is funded by the National Park Service, along with a similar IWS study on the prehistoric Anasazi cliff dwellings in Colorado.

CENTERING ON WASTE

News from the Hazardous Waste Research and Information Center (HWRIC)

Progress on Hazardous Materials Laboratory

The preliminary design for the Illinois Department of Energy and Natural Resources' (DENR) $8.7 million Hazardous Materials Laboratory (HML) has been completed. The HML will be a state-of-the-art facility specially designed to safely handle hazardous wastes and materials. Groundbreaking at the lab's site on the University of Illinois' Champaign campus is scheduled for this October.

HWRIC Director Addresses Chemical Industries Council

David Thomas, Director of HWRIC, addressed the Council's Environmental and Governmental Affairs Committee in Chicago on February 18. Closer cooperation between the two groups was discussed, as was the new Hazardous Materials Laboratory.

"Small Quantity Generators' Manual" Published

HWRIC Industrial Assistance Engineer Daniel D. Kraybill compiled this manual specifically for Illinois businesses that generate small quantities of hazardous wastes. The manual contains up-to-date information on federal and state regulations, waste management alternatives, how to choose a waste firm, and lists of waste management companies. Copies are free and can be obtained by calling (217) 333-8940.

Household Hazardous Waste Plan Submitted to Cities

Christina Komadina, HWRIC Information Coordinator, has submitted a detailed plan for a household hazardous waste collection program to the cities of Champaign-Urbana. Approval for the program could come in early May. If approved, it will be the first such program in Illinois.

The Greater Prairie-Chicken in Illinois

At one time prairies covered some 60 percent of "The Prairie State," and the prairie-chicken (*Tympanuchus cupido pinnatus*) was an important part of that massive ecosystem. Bones of prairie-chickens have been found in kitchen middens of the Middle Mississippi prehistoric culture of Cahokia, indicating that as early as 1200 A.D. prairie-chickens played an important part in the human culture of Illinois. Ceremonial dances and dress of certain Indian tribes imitated the dance and display of Illinois' native grouse.

Tragically, within the last century the uncounted millions of birds that inhabited hundreds of thousands of acres of Illinois grasslands have dwindled to only a few hundred. The greater prairie-chicken is now a state endangered species. There are now only 1,960 acres comprising Illinois' prairie-chicken sanctuaries, all in Jasper and Marion counties.

What follows is a closer look at Illinois' Prairie Boomers.

Size and Appearance

The prairie-chicken is Illinois' native prairie grouse, resembling nothing so much as a small barnyard hen. The birds are dark brown and tan with dark bars over most of their bodies. Males average between two and two and one-quarter pounds, while hens weigh about one pound, ten ounces on the average.

The male prairie-chickens have bright orange eyebrows and tufts of feathers (called pinnae) on the sides of their necks. The pinnae resemble horns when prairie-chickens engage in their mating displays, called "booming." The most fascinating feature of the male chicken is the inflatable airsacs (tympani) on its neck. These orange sacs serve to resonate the "booming" sound produced by the male in the mating ritual. On a quiet morning, this sound can be heard up to three miles. Females do not have the bright eyebrows of the males, and their air sacs are much smaller than those of the cocks.

Prairie-chickens are closely related to the sharptail and distantly related to the pheasant, quail, ruffed grouse, turkey, and Hungarian partridge. All of the birds have in common two characteristics: they walk as much as they fly even though they are capable of fast sustained flight, and they nest on the ground. Mating rituals are also similar, involving a display that includes noise, strutting or dancing and feather display. The prairie-chicken's mating display, however, is by far the most spectacular.

Range and Distribution

According to Illinois Natural History Survey researchers Ronald Westemeier and William Edwards, greater prairie-chickens are still found in four states in numbers sufficient for hunting: Kansas, Nebraska, South Dakota and Oklahoma. They are found in much fewer numbers in six other states, including Illinois. The species no longer exists in eight other states and four Canadian provinces.

The number of chickens in Illinois places them among the most endangered of all states where the birds still occur. The spring census of 1985 indicated that only 153 cocks, and thus a total of no more than 300 birds, still live in Illinois. There are two flocks still surviving on 14 tracts jointly managed by The Nature Conservancy, the Illinois Department of Conservation, and the Illinois Natural History Survey. One flock, in Jasper County, is severely threatened by one of the prairie-chicken's worst rivals, the pheasant. Pheasants are not present to threaten the second flock, in Marion County. Acquisition objectives call for an additional 1,000 acres in scattered tracts averaging 160 acres each.

Prairie-chickens originally thrived because of early settlers in Illinois. These settlers lived mostly in wooded areas and along waterways because of a need for lumber and transportation. Prairies were avoided, and the initial clearing of forests aided the prairie-chicken in expanding its range from the prairies onto woodland soils. However, in the 1860's the steel plow developed by John Deere made rapid inroads into the prairie grasslands and the chicken's habitat. At first the intermixture of prairies and fields of grain caused optimum habitat for the birds. The *American Sportsman* of December 27, 1871 stated that 600,000 prairie-chickens were bought annually by the Chicago trade.

As late as 1912 prairie-chickens existed in 92 of Illinois' 102 counties. Their populations greatly declined, not only because of land-use changes, but also because of large-scale releases of ringnecked pheasants. Harassment of prairie-chickens by pheasants on booming grounds became common. Of even greater significance was the innate proclivity of pheasants to parasitize the nests of the chicken. As Westemeier and Edwards explain, "Pheasant chicks produced in prairie-chicken nests represent a 'bonus' achieved at little expense to pheasants but at great cost to the parasitized prairie-chickens."

Food Habits

Prairie-chickens enjoy a diverse menu, from insects and greens in summer and autumn to fleshy fruits, weed seeds and

Illinois' prairie-chicken

Illinois Natural History Survey

small grains as soon as they ripen and for as long as they remain available. In autumn and winter, corn, buds and catkins are added to the bird's diet.

Prairie-chickens eat throughout the day, although the main feeding periods seem to be about 2 hours in the morning, shortly after sunrise, and for an hour or more before sundown.

Breeding and Social Ecology

The prairie-chicken's spectacular mating display begins on clear days in fall and continues, at lesser frequencies, through the winter. The peak of the courtship period occurs in April and May, when cocks arrive on the booming grounds approximately 45 minutes before sunrise and boom and display for 2 or more hours. The cocks resume their display for about an hour before sunset. Since the point of the display is to see and be seen, the cock's preferred booming ground is usually on flat or slightly rolling territory devoid of cover. Jim Lockart described the ritual in his pamphlet, "The Last Chance:"

> One begins his show with a short run and a sudden stop. You hear a drum-like patter as he stamps his feet, he bows, the pinnae on his neck are erect like horns and pointing straight forward as though he were a bull sizing up a matador, his air sacs fill, and you hear the boom.

Fights between cocks defending their small portion of the booming ground do occur, but they are more feathers than blood. Hens appear to ignore all the show, but in reality may mate with several cocks. In mid-April, the hens begin to construct their nests, made of dead grass, stems and leaves. Clutches are usually ten to twelve eggs, and incubation begins in late April or early May, with the eggs hatching after some 25 days of incubation, about 40 days after the first egg is laid. The hens lead the chicks away from the vulnerable nest as soon as they can and to areas open enough for easy cover and with a good supply of insect food. Broods break up after the young are ten weeks old. In late fall and winter the birds gather in flocks of 50 or more and roost in stubble or grass. Winter activities include roosting, feeding and resting.

Sanctuary

The prairie boomer is an adaptable species given a reasonable chance. Acquisition of additional sanctuaries and federal programs of cropland diversion, especially where perennial grasses and legumes are planted and where pheasants do not endanger the boomer, have considerable potential to benefit the prairie-chicken.

For more information on Illinois' prairie-chicken, INHS researchers Ronald Westemeier and William Edwards have written a chapter entitled "Prairie chickens and Pittman Robertson in the Midwest: An Historical Perspective," which will be published in Restoring America's Wildlife, *a book reviewing 50 years of Pittman-Robertson federal aid to wildlife programs, available from the U.S. Fish and Wildlife Service, Washington, D.C.*

Nevling named Natural History Survey Chief

Dr. Lorin I. Nevling, former Director of the Field Museum, has been named Chief of the Illinois Natural History Survey. He assumed head administrator duties of the 128-year old Survey on January 2, and succeeds Acting Chief Lawrence Page.

The Natural History Survey is the largest biological survey in the nation and the second oldest. Nevling supervises approximately 230 scientific and technical staff, including 94 Ph.D.'s.

"The Natural History Survey is the premier organization of its kind in the nation," Nevling said. "This is the result of a far-sighted state administration, an extended data base, major collection and equipment resources and a staff of dedicated, productive scientists. Together, these elements make the Survey what it is today. The challenge to be met is to provide significant service to the citizens of Illinois and increase our scientific standing during a period of fiscal austerity. Great organizations find the will and the way to move ahead during difficult times. I am confident in the Survey's ability to do so."

As the former Director of the Field Museum in Chicago, Dr. Nevling is a seasoned administrator with extensive experience in the arts, humanities and science. He left Harvard University in 1973 to become Chairman of the Department of Botany at the Museum. He advanced to the position of Assistant Director for Science and Education, and in 1980 he became Director of the Museum.

From 1959 to 1973, Dr. Nevling was at Harvard University, where he was employed by the Arnold Arboretum, the Gray Herbarium, and the Farlow Herbarium. Besides conducting extensive research in the United States and abroad, Dr. Nevling has authored more than 75 scientific articles, serves on several boards, and holds many professional appointments.

Dr. Nevling received a Bachelor's degree in Biology from Saint Mary's College in Winona, Minnesota. Following two years of service in the military, he earned his Master's and Ph.D. degrees from Washington University in St. Louis.

Dr. Nevling and his wife, Jan, are the parents of five children. He is a native of St. Louis.

New Director of Illinois Department of Conservation

Governor James R. Thompson recently appointed Mark Frech as Director of the Illinois Department of Conservation. Frech, of Springfield, replaces Michael Witte, who resigned the position in December, 1986 to enter private business.

A native of Carrollton in Greene County, Frech attended Illinois College in Jacksonville, where he received a Bachelor's degree in 1973. Frech, 36, served as Assistant Director of Admissions at Illinois College from 1973 to 1977, then went into private business in Jacksonville from 1977 to 1980.

Frech joined the Governor's Office in 1980, serving as Assistant Director of Personnel. He was promoted to Director of the Governor's Personnel Office in 1984. He resigned his position in October, 1985 to serve as the Deputy Campaign Manager for the re-election of Governor Thompson.

Frech was appointed to the Conservation Advisory Board by Governor Thompson in 1984, a position he held until his appointment as Director of Conservation. His interests include hunting, fishing, camping and other outdoor-related activities.

Dept. of Mines and Minerals Head Appointed

Governor James Thompson has appointed Richard Shockley, a former Inland Steel Company executive, to head the Illinois Department of Mines and Minerals. Shockley replaces Bradley Evilsizer, who served as head of the department for the past 10 years.

Shockley, 57, of Benton, was employed by Inland Steel Corporation for 35 years, serving as Manager of Administration from 1979 until his retirement in November, 1986. Since then, he has been a consultant in the mining industry. He earned a Bachelor's degree in Mining Engineering from Virginia Polytechnic Institute and State University in 1952.

Shockley's nomination must be confirmed by the state Senate.

Board Profiles

Gaylord Donnelley, Chairman of the Board

Gaylord Donnelley, Honorary Chairman of the Board of R.R. Donnelley & Sons Company, has served as the Society's Chairman of the Board since 1984. A resident of Libertyville, he has served in various capacities with Ducks Unlimited, Inc., including President. He is a Trustee of the North American Wildlife Foundation and an Honorary Director of the Open Lands Project, as well as a member of The Nature Conservancy. Mr. Donnelley served as a member of the advisory board of the Illinois Department of Conservation from 1978 to 1984. He is a recipient of the Prairie Chicken Foundation of Illinois Honor Award in 1969, the Nature Conservancy Oak Leaf Award in 1976 and the Conservation Merit Award from the Illinois Department of Conservation in 1981. He is a graduate of Yale University.

Edmund B. Thornton, Vice Chairman

Ed Thornton is the Chairman of Ottawa Silica Company in Ottawa, Illinois. He serves as an Advisor to the Illinois Nature Preserves Commission and the Illinois Abandoned Mined Lands Reclamation Council and is Chairman of the Illinois & Michigan Canal National Heritage Corridor Commission. Mr. Thornton is a trustee of the Illinois Chapter of the Nature Conservancy and a life member of the National Rifle Association and Ducks Unlimited. He is a member of the National Audubon Society, National Wildlife Federation, National Oceanographic Association, American Polar Society and the Arctic Institute of North America. Mr. Thornton served aboard the Schooner Bowdoin with Admiral MacMillan on two expeditions to the Arctic in 1949 and 1950. He is responsible for the concept, design and construction of Thornton Park and recreation area in Ottawa and Mr. Thornton conceived and commissioned the unique site sculpture project, Buffalo Rock Effigy Tumuli, designed by artist Michael Heizer in 1984 and 1985. He is a graduate of Yale University.

Walter E. Hanson, Treasurer

Walter Hanson founded the firm of Hanson Engineers, Inc., (originally known as W.E. Hanson & Associates) in 1954. The firm has grown to serve clients and projects in 50 states and 13 foreign countries. Mr. Hanson, a resident of Springfield, is a member of the Board of Natural Resources and Conservation, and has served as an officer and/or committee member in addition to his memberships in the American Society of Civil Engineers, National Society of Professional Engineers, Illinois Society of Professional Engineers, Illinois Society of Professional and American Consulting Engineers Councils, to mention a few. He has authored or coauthored a number of publications in the engineering field, most significantly, *Foundation Engineering*, coauthored with Professors R.B Peck and T.H. Thornburn. This engineering textbook, in its second edition, is widely used by practicing engineers and students throughout the world. He holds degrees from Kansas State University and the University of Illinois

James R. Anderson, Jr.

James Anderson is Chairman and Chief Executive Officer of Chicago Extruded Metals Company in Hinsdale, Illinois. He is a Director of the Copper and Brass Fabricators Council and serves as a Trustee in both the Berkshire School of Sheffield, Massachusetts and with the Illinois Chapter of the Nature Conservancy. Mr. Anderson received degrees from Yale University and served as a marine aviator from 1942 to 1945.

Henry N. Barkhausen

Henry Barkhausen is a former Director of the Illinois Department of Conservation, having served under Governor Ogilvie. He retired as Chief Executive Officer of Midwest Lime Company in Batesville, Arkansas in 1980, and now operates a small hill farm in Union County in southern Illinois. Mr. Barkhausen serves as a Conservation Representative on the Advisory Council on Mine Reclamation to the Department of Mines and Minerals, and is a Trustee of the Illinois Chapter of The Nature Conservancy and Director of the Association for Great Lakes Maritime History. He also serves as a Director of the Anna State Bank, and was on Governor Thompson's Fiscal Commission in 1980 Mr. Barkhausen is a 1936 Yale University graduate

George Farnsworth, Jr.

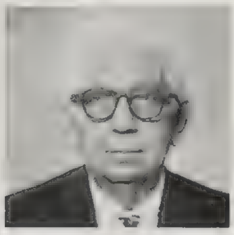
George Farnsworth is a partner in the engineering firm, Farnsworth & Wylie, P.C., in Bloomington, Illinois. Farnsworth and Wylie handles the design and construction guidance of wells and surface water supplies, water treatment plants, sewer collection systems, municipal and industrial wastewater treatment plants, land drainage, bridges and transportation systems. Mr. Farnsworth is a member of the following professional groups: American Society of Civil Engineers, American Concrete Institute, American Waterworks Association, Water Pollution Control Federation, Illinois and National Societies of Professional Engineers and the Illinois and American Consulting Engineers Councils. He is a graduate of the University of Illinois.

Marshall Field V

Marshall Field is Chairman of The Field Corporation, a company with three affiliates: Field Publications, Pioneer Press and Manistique Papers, Inc. Field Publications markets a wide variety of published materials to schools, students and families. Pioneer Press publishes newspapers and a quarterly magazine in the suburbs of Chicago. Manistique Papers, Inc., manufactures newsprint and specialty papers. Mr. Field is also Chairman of Cabot, Cabot & Forbes, a real estate company. He is Vice Chairman of the Board of Trustees for the Field Museum of Natural History and also serves on the Board of Trustees for the Museum of Science and Industry. Mr. Field serves as Chairman of the McGraw Wildlife Foundation and Treasurer of Restoration of Atlantic Salmon in America, Inc. He also serves on the boards of Trout Unlimited, Lincoln Park Zoological Society and the Open Lands Project. He is a member of the Chicago Zoological Society, the Brookfield Zoo Board of Advisors and The Nature Conservancy. He is a graduate of Harvard University.

Clayton R. Gaylord

Clayton Gaylord, of Rockford, Illinois, was employed at Ingersoll Milling Machine Company from 1946 until his retirement in 1984. He still serves as Director and Chairman of the Finance Committee. He served as President from 1958 to 1971 and Chairman of the Board from 1971 to 1972. Mr. Gaylord is a Trustee of the North American Wildlife Foundation and also serves on the group's executive committee. He is Chairman of the Board of the Rockford Institute and a Director of the Ingersoll Foundation. Mr. Gaylord is a graduate of Princeton University.



Ralph E. Grim

Dr. Ralph Grim is a Professor Emeritus in the Department of Geology at the University of Illinois. He worked at the Illinois Geological Survey from 1931 to 1948, where he began his detailed studies of clays. Dr. Grim developed a series of x-ray, thermal and chemical methods to study the structure and properties of clays. The papers published over the next fifty years are a fascinating blend of pure science at its best and the application of the results to agriculture and industry. In 1974, the Mineralogical Society of America presented the Roebling Medal to Dr. Grim. The award recognized Dr. Grim as the "Father of Clay Mineralogy". He also served as a Consultant to the Ivory Coast and has conducted research in many foreign countries. He holds degrees from Yale University and the State University of Iowa.

John F. Homeier

John Homeier is President and Principal Owner of Bi-Petro, Inc., a company that buys and sells crude oil, operates producing wells and provides various types of oilfield services. In addition, along with his three sons, he owns an exploration company, Homco Ltd. Over the years Mr. Homeier has been very active in various organizations related to the oil industry. He is currently serving as a member of the Governor's Advisory Commission on Oil and Gas Legislation, and is a Director of the National Petroleum Refiners Association and Independent Petroleum Association of America. He holds memberships in a number of petroleum associations, including the Independent Petroleum Marketing Association of America. In 1979 the oil industry honored him with an award for outstanding oil operator in Illinois. A native of Springfield and a graduate of the University of Illinois, Mr. Homeier is active on the boards of many Springfield community organizations.

Richard A. Lenon

Richard Lenon is Chairman and a member of the Board of International Minerals & Chemical Corporation, located in Northbrook. He served as Chief Executive Officer from 1971 until 1983 and also served as President from 1970 to 1978. Mr. Lenon is a Director of Allis-Chalmers Corporation; American

Standard Inc.; Bankers Trust Company and Bankers Trust New York Corporation; Federal Paper Board Company; Allied-Signal, Inc.; the American Mining Congress; Chicago Museum of Science and Industry; Chicago Museum of Contemporary Art; and Evanston Hospital Corporation. He is a Trustee of the Illinois Institute of Technology. Mr. Lenon is a graduate of Western Michigan University.

John Rednour, Sr.

John Rednour, a resident of Du Quoin, is President of R & H Construction Company, Inc. He has also served as President of Rednour Steel Erectors, Inc., Chairman of the Board of Air Illinois, Inc., on the Board of Directors of the Du Quoin State Bank, Chairman of the Board of Cater-Vend, Inc., Director of Perry County Leasing, Inc., on the Board of Directors of Southern Illinois Builders Association and the Board of Directors of the First National Bank in Altamont. Mr. Rednour is a Director of the Du Quoin Business Association and serves on the Executive Council of Southern Illinois, Inc., and the Board of Directors of the Du Quoin Boys Club.

William A. Rooney

Bill Rooney is a native of LaCrosse, Wisconsin. He began his 40-plus year career in advertising there and continued it in St. Louis where he worked in advertising at Union Electric and Monsanto Company. Mr. Rooney served as Advertising Manager of the Organic Chemicals Division at Monsanto. He moved to Chicago in 1954 continuing his involvement in advertising, where he became a Group Vice President of D'Arcy Advertising Company. His lifelong interest in architecture prompted him to author a book, *Architectural Ornamentation in Chicago,* published in 1984. Mr. Rooney wrote the text and took the 675 pictures appearing in the book. He received the Distinguished Service Award from the American Institute of Architects Chicago Chapter in 1985 for the book and for his work in architectural preservation. In retirement, Mr. Rooney continues actively providing communications consulting services to various clients.

William L. Rutherford

William Rutherford is an attorney in Peoria who, with his wife Hazel, designed and built Wildlife Prairie Park. He is a former Director of the Illinois Department of Conservation. Mr. Rutherford has served as Administrative Vice President, Treasurer and Director of the Forest Park Foundation, and has been its attorney since incorporation in 1939. Since 1964 he has spearheaded a drive which added over 20,000 acres to the land available for park, recreation and wildlife purposes in the Peoria area. He has served on a number of community, state and national advisory boards and committees. Mr. Rutherford is a past member of the Air Pollution Control Board and past Vice-Chairman of the State Sanitary Water Board. He is a member of the board of directors for both the Illinois Wildlife Federation and the Sierra Club Legal Defense Fund. In 1986, he was named one of the "One Hundred Heroes in America" by *Newsweek* magazine. He is a graduate of Bradley University and the University of Chicago.

Jeffrey R. Short, Jr.

Jeffrey Short, President of J.R. Short Canadian Mills Limited and J.R. Short Milling Company, is a resident of Winnetka. Mr. Short is an Honorary Trustee of the Chicago Zoological Society and a Trustee of the L.S.B. Leakey Foundation. He is a Director of the Open Lands Project of Chicago, having served as President from 1963 to 1972; a Director of the Wildlife Trust, Slimbridge, U.K.; and a member of the President's Council, World Wildlife Fund, and the President's Council of the National Audubon Society. Mr. Short has received a number of awards including the Garden Club of America - Frances K. Hutchison Medal for Conservation 1983, and the Oak Leaf Award from The Nature Conservancy. He is a graduate of Harvard University.

[illegible]

Joe Spivey is President of the Illinois Coal Association, a trade organization which represents the coal industry in the state of Illinois. It is located in Springfield. Mr. Spivey has been extensively involved in the energy industry since 1972 and has held his present position with the Coal Association since 1978. A native of North Carolina, Mr. Spivey is a veteran of the U.S. Marine Corps. He served seven years and four months in the South Pacific, Atlantic and Mediterranean. Mr. Spivey's educational background includes a degree in political science, education and economics. He presently resides in Petersburg.

Harold B. Steele

Harold Steele, a livestock and grain farmer in Princeton, is the former elected President and full-time Executive Officer of the Illinois Farm Bureau for 13 successive elections of this 315,000 member family organization. In addition to his executive role in Farm Bureau, he also served as President of the IFB-affiliated group of insurance companies — Country Life Insurance, Country Mutual Insurance, Country Casualty, Mid-America Investors Life Assurance and Mid-America Preferred Insurance. He also served as President of the Farm Bureau-affiliated IAA Trust Company, Country Capital Growth Fund, Country Capital Income Fund, Country Capital Money Market Fund, Country Capital Management Company, C.C. Services, Illinois Agricultural Holding Company and Illinois Agricultural Service Company. Steele served on the coordinating committee of GROWMARK, INC., the farm production supply and service organization affiliated with the state farm production supply and service organization affiliated with the state Farm Bureaus in Illinois, Iowa, and Wisconsin. Mr. Steele is on the Board of Directors for the Midwest Financial Group, Inc., and is a presidential appointee to the National Commission on Agricultural Finance.

Susan C. Stone

Susan Stone has served as a member of the Illinois Commerce Commission since 1984. Prior to her appointment she was a Program Planning Consultant to the Central Illinois Economic Development Corporation, and a Special Assistant to the State Director and Rural Development Coordinator for the Farmers Home Administration, U.S. Department of Agriculture. She has held a variety of positions involved in federal, state and local government problem solving. From 1971 to 1984 she was an elected Commissioner and Vice President of the Urbana Park District, and from 1983 to 1984 served on the Board of Directors of the Illinois Association of Park Districts. Mrs. Stone is a Founder, Past Chairman and board member - and sometimes Executive Director - of the Champaign County Development Council (CCDC). She received the CCDC Foundation Award in 1984 and in 1981 received an honor award nomination, U.S. Department of Agriculture Distinguished Service Award for "Effective Development, Implementation and Continued Dedication to a Realistic Plan for the Preservation of Prime Agricultural Lands". She is a graduate of Mt. Holyoke College and John Hopkins University.

Warren T. Trask

Warren Trask is Group Vice President, Technical Operations, at A.E. Staley Manufacturing Company in Decatur. His responsibilities encompass the areas of engineering, purchasing, research, management information systems, environmental science and corporate transportation. Mr. Trask joined A.E. Staley in 1977 as Vice President, Industrial Manufacturing, with responsibility for corn plant operations. Prior to that he was employed by Mallinckrodt Chemical in St. Louis for 20 years. He is a past President of the Chemical Council of Greater St. Louis and the Decatur Boys' Club, a past board member of the American Institute of Industrial Management of Missouri, and a past member of the Governor's Council on Economic Development-North Carolina. Mr. Trask has degrees from Monmouth College and Iowa State University.

Leo Whalen

Leo Whalen is a resident of Hanover, in northwestern Illinois. Mr. Whalen is the Founder and President of Whistling Wings, Inc. Whistling Wings, Inc., is a family-owned farm and business that produces wild mallard ducks for worldwide shipment. The business, established in 1954, is celebrating its 33rd anniversary in 1987.

Louise B. Young

Louise Young, author of a number of nonfiction books, is a resident of Winnetka. She serves as a Director on the Board of the Open Lands Project and has served as a Director with the Lake Michigan Federation and Citizens for a Better Environment. Mrs. Young was a member of the Environmental Advisory Committee for the U.S. Department of Energy from 1978 to 1981. She received the Carl Sandburg Literary Arts Award for *The Blue Planet* from Friends of the Chicago Library, for the best nonfiction of 1982-83. *The Blue Planet* was also selected as the best book of nonfiction in 1983 from the Society of Midland Authors. Mrs. Young is also the Author of *Best Foot Forward*, a children's book, and *Power Over People, Earth's Aura,* and most recently, *The Unfinished Universe,* published by Simon & Schuster, 1986. She is a graduate of Vassar and the University of Chicago.

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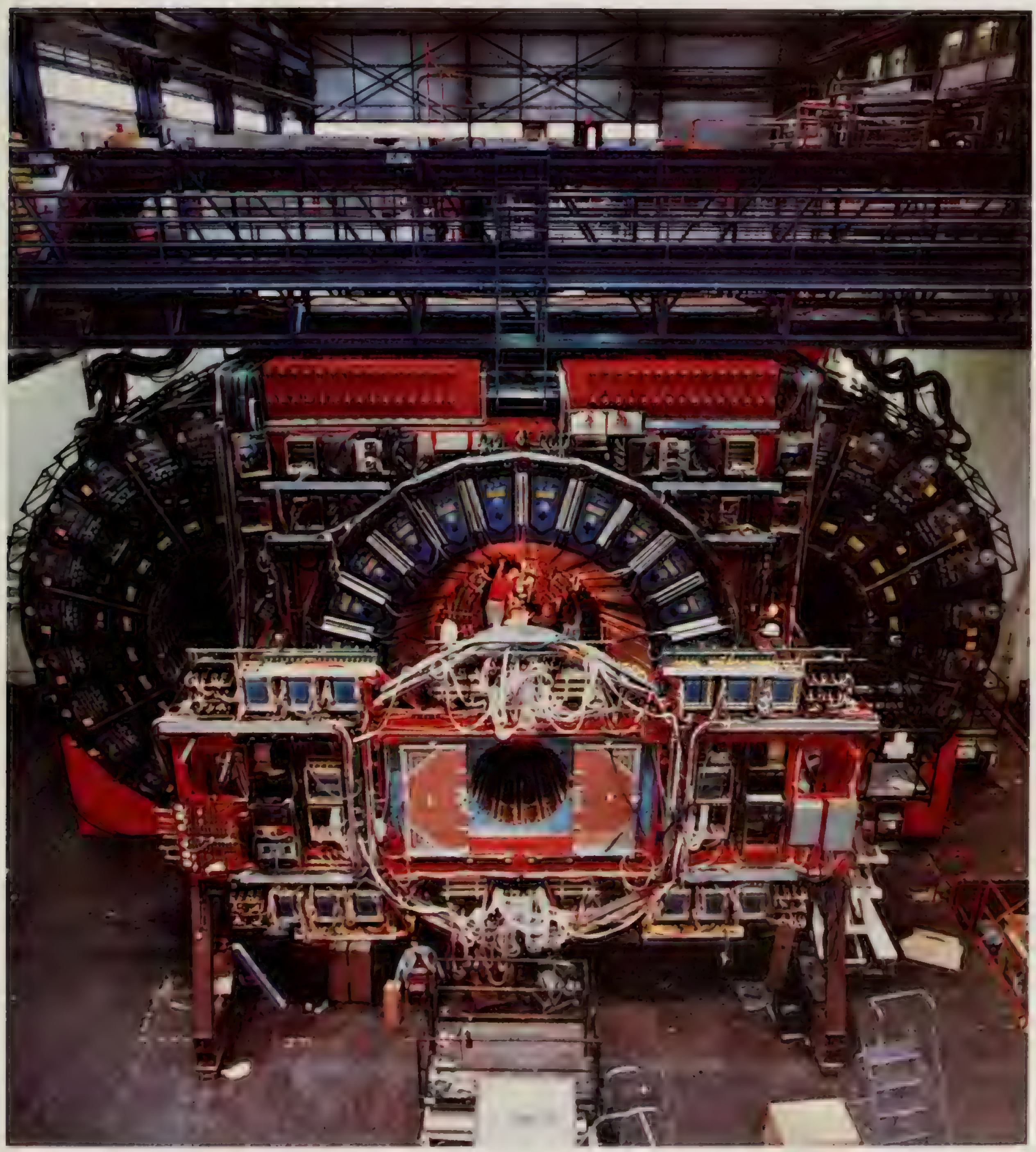

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About the Cover
The collider detector at Fermilab. In this view, two of the arches making up the central calorimetry system can be seen at each side of the detector. Also visible is much of the forward calorimetry. The detector stands two stories tall, weighs 4500 tons, and was built by a collaboration of more than 170 physicists from the U.S., Japan and Italy.

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Editorial Staff

Jane A. Bolin
Editor

ComUnigraph
Design and Production

Society Offices

Correspondence about memberships, magazines deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 1525 South 6th Street, Suite B, Springfield, IL 62703

The Society encourages readers to submit letters to the editor of **The Nature of Illinois** at the address above

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* *Contributions of $200 or more*

The Society Page

The fourth issue of **The Nature of Illinois** brings you more information on what the Surveys are and what they are doing to make Illinois a better state for us all.

For four years, the scientists of the three Surveys have been laboring to make **the Superconducting Super Collider** (SSC) a reality for Illinois. This $4.4 billion project will mean thousands of jobs for Illinois, will create approximately $1.5 billion for the local economy and other businesses throughout the state, and will bring an additional $115 to $140 million in state tax revenue.

The Natural History Survey has also been working on new business for Illinois — a new industry called **aquaculture.** Growing fish in Illinois may seem exotic, but several small farmers have already turned this unusual crop into a profitable venture.

Renovation of the Illinois and Michigan Canal is a project close to my heart. Much of the Canal's future depends on devising a water flow control system, and Survey scientists are working with the Illinois Department of Conservation to bring this early part of Illinois' history back to life.

The Surveys' efforts in preserving our natural — and national — heritage are not restricted to work in Illinois. At the **Gettysburg National Military Park,** the Water Survey's staff is investigating ways to save that well-known battlefield's famous monuments from the effects of airborne acidic pollutants.

Protection of the environment is one of the most important missions of the Surveys. In this issue you will find two good examples of their work in that area: research by the National History Survey on **endangered plant species** and the work of the Geological Survey in preventing expensive damage from **mine subsidence.**

The Society for the Illinois Scientific Surveys, a group of lay friends of the Surveys, brings you this magazine as one way of telling Illinois citizens about the wealth of expertise they have in their three Scientific Surveys.

Please join me in becoming a member of the Society, a 501(c)3 tax exempt organization. Take a little time now to fill out the membership card in this issue and join me in becoming a "friend" of our invaluable, hardworking Survey scientists.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

The Society for the Illinois Scientific Surveys

Scale of Contributions

Personal Memberships

Founding	$1,000 per year
Contributing	100 per year
Family	50 per year
Individual	25 per year

Corporate/Business Memberships

Founding	$10,000 per year
Benefactor	5,000 per year
Associate	1,000 per year
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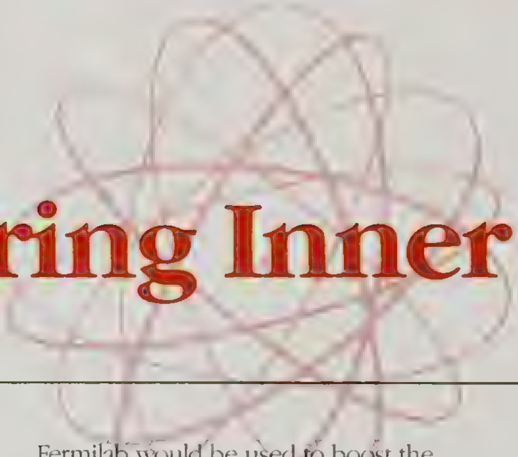
Patron	250 per year

Exploring Inner Space



The Superconducting Super Collider (SSC), recently approved by the White House and now under scrutiny in Congress, will be the world's most powerful particle accelerator, a scientific instrument for exploring the basic structure of nature. Analogous to a telescope for examining stars, the SSC will allow scientists to "see" inner space — the subatomic particles (quarks, gluons and bosons) — that hold the universe together.

Simply put, the SSC will be an atom smasher unlike any other atom smasher that exists today. Fermilab's Tevatron in northern Illinois is now the most powerful accelerator in the world. The Tevatron accelerates proton and antiproton beams to one trillion electron volts (1TeV) and then smashes them together, creating energy and subatomic debris used by scientists to examine subatomic particle structure.

When constructed, the SSC will accelerate protons to 20 trillion electron volts (20 TeV), colliding these beams at nearly the speed of light. As the beams collide and the protons smash together, they release huge amounts of energy and reveal new particles to waiting physicists. The higher the energy of the beams, the greater the force of collision, the more likely new particles will reveal themselves. Giving physicists a larger machine will allow them to study smaller and smaller particles.

Many states are vying for the $4.4 billion SSC, Illinois among them, with Fermilab as the proposed site. Illinois is proposing an oval-shaped ring 53 miles in circumference buried below northern Illinois' cornfields. The main tunnel, about 10 feet in diameter, would be carved from bedrock 300-500 feet underground. Three smaller accelerators at Fermilab would be used to boost the energy of the particles before they are injected into the main ring, a system that could result in construction savings of up to $500 million. Inside the main tunnel 6,000 to 8,000 super-cooled electromagnets will bend and focus the proton beams, keeping them in a circular orbit. Along the ring, six experimental halls will house huge electronic detectors designed to measure the effects of the colliding beams.

■

Technology associated with accelerators has already yielded some notable economic successes. Most homes already have a number of accelerators.

■

The SSC is a collider, not a fixed-target accelerator. In a collider, two counter-rotating beams collide head-on in intersecting regions located along their path. A collider allows virtually all the combined energy from the colliding particles to be available for creation of new matter. This is not the case with a fixed-target machine, where most of the energy from the projectile particle is wasted in forward motion of the collision products.

Why an SSC?

The first blow came in 1982. American scientists scoffed at the European physics consortium's (CERN) decision to ram protons and antiprotons together in their Super Proton Synchroton. But the experiment succeeded. In 1983 Carlo Rubbia and Simon Van der Meer and their CERN colleagues discovered three new particles, positive and negative bosons called the W's and a neutral boson known as the Z-zero. In 1984 Rubbia and his associates brought home the Nobel Prize for physics. The American scientific community had lost its preeminence in high energy physics.

Beyond the somewhat parochial goal of recouping America's high energy physics prestige, the SSC will help scientists to discover the fundamental laws of nature. What are the basic forms of matter? What is energy? How can they be changed from one to another? The high energy densities in the SSC's collisions cannot be found anywhere else in the universe. In the context of the Big Bang theory, such temperatures only existed in the birth pangs of the universe. In a very real sense, the SSC brings us back to our "roots."

New technologies are a third and compelling reason for constructing the SSC. Technology associated with accelerators has already yielded some notable economic successes. Most homes already have a number of accelerators. A television is an electron accelerator. A microwave oven contains a klystron (a special kind of electron accelerator) which makes the microwaves which do the heating. The basic industry of manufacturing superconducting wire catalyzed a new medical industry and diagnostic tool that complements the use of X-rays. Magnetic resonance imagers study the body when a patient is placed in a magnetic field using a superconducting magnet.

Superconductivity in general is especially promising because it conducts electricity with zero resistance. Motors

Geological Survey staff drill test holes for Illinois' proposed SSC site near Fermilab

Illinois Geological Survey

and generators using superconducting components would be smaller and more efficient, losing less electrical energy as waste heat. Other possible by-products of superconducting energy include:

Magnetically-levitated trains using superconducting magnets to support the train and to serve as a propulsion source. Japan is even now working on a model.

Fusion energy experiments using superconducting magnets are underway at Oak Ridge and Livemore labs.

Superconducting transmission lines could help in locating power facilities away from densely populated areas.

Water purification, magnetic ore separation, and more.

Two other practical applications from accelerator technology include **parallel processing in computer design,** enabling the manipulation of large quantities of needed data; and the large scale production of antimatter thought of as critical to **rocket engines for interstellar travel.**

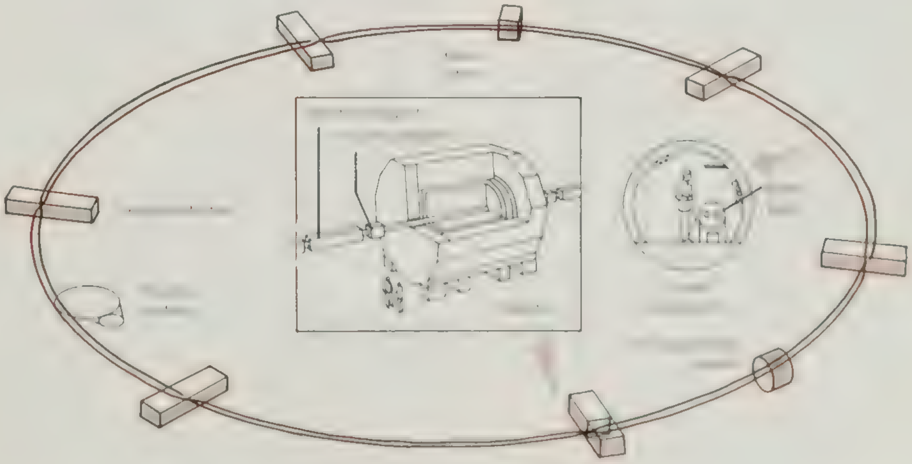
The Bottom Line

There are good reasons why Illinois and upwards of 28 other states are submitting bids to the U.S. Department of Energy to host the SSC: 8,000 construction and related local jobs annually, 3,000 permanent positions at the site, $1.5 billion in additional real disposable personal income, between $115 and $140 million annually in state tax revenues, and international prestige.

Each state is trying to make its package as attractive as possible. Because it already hosts Fermilab and the Tevatron, Illinois can offer federal officials up to $1/2 billion in savings by using the Tevatron as an injection system. Widely acknowledged as one of the leading states in the SSC race, Illinois has already spent $4.5 million on feasibility studies, and additional Build Illinois funds are available. Illinois' three Scientific Surveys and the State Museum, under the Department of Energy and Natural Resources, have conducted extensive preliminary siting studies. Private support has come from SSC For Illinois, a not-for-profit foundation.

The other leaders in the SSC race are:

- **Arizona:** two sites and significant private support
- **California:** two sites proposed, a strong lobbying effort, a press report of a $2 billion incentive package, and opposition from agricultural interests
- **Colorado:** two sites proposed, good tunneling formation, and talk of a coalition with other western states.
- **Idaho:** one site at the National Engineering Laboratory; the advantages of a large block of federal land and the disadvantage of a remote location.
- **New York:** several sites mentioned and the advantage of cheap hydroelectric power from Canada
- **North Carolina:** one site north of Durham, a good track record in high tech with Research Triangle Park nearby, but some controversy about micro-seismic noise — vibrations from the coastline.
- **Ohio:** one site near Columbus, $1¼ million in studies, and a substantial effort by the Ohio Geological Survey
- **Texas:** probably two sites, a strong lobbying effort and a reported $1 billion in incentives



Schematic of a possible layout for the SSC, which will be roughly 100 kilometers in circumference. The injection system is drawn to scale; the six experimental halls and other components on [illegible] are not. In the detail of the detector, the beam pipe and its magnets are shown oversize. [illegible]

- **Utah:** two sites and a proposed cut-and-fill construction technique.
- **Washington:** one site west of Spokane, cheap power and talk of a coalition with Oregon and Idaho.

Siting It Safely

Illinois' three Scientific Surveys — the Geological, Natural History and Water Surveys — along with the State Museum have been involved in intensive investigations into the environmental and geological feasibility of the proposed Fermilab site for the SSC. This work becomes even more valuable as the states receive clear signals from the federal government that a full environmental impact statement will be required.

Scientists at the **Illinois Geological Survey** (IGS) found that the bedrock in northeastern Illinois looked promising for the SSC ring. Seismic activity in the area is minimal. Only seven earthquakes have been centered in northern Illinois since 1804, and none was large enough to do damage to manmade structures. Radiation from a tunnel constructed in bedrock 300 to 500 feet below land surface would be virtually non-existent. Projected groundwater inflow into the tunnel would be very low.

The first part of a test drilling program was conducted by a team of IGS scientists headed by Dr. John Kempton in the fall of 1984 to determine the type, depth and engineering properties of the bedrock and overlying glacial materials. 17 holes were drilled to a depth of 50 feet below the proposed tunnel on a regional basis since the exact dimensions of the SSC ring had not yet been determined by the SSC Design Group. Results confirmed previously available data: sound geology and excellent conditions for tunneling.

Test holes 18 to 30 feet were drilled from last spring to December, 1986, based upon the now confirmed 53-mile ring size. Three larger, eight-inch diameter holes were also drilled to depths of 900 to 1100 feet. These holes gave IGS scientists data on the strength of the rock, natural radioactivity background, groundwater levels and flow, vibration velocity and very precise information on where the rock changes. These studies were augmented by seismic refraction and reflection surveys. 200 miles of refraction surveys in the SSC corridor verified the depth to bedrock. A test line reflection profile of 3½ miles allowed the scientists to see the surface changes in the bedrock.

Overall the results confirmed that the project area is underlain with thick, homogenous rock that allows safe, cost-effective tunneling. Water seepage into the tunnel area and impact on aquifers and water resources will be minimal.

Other potential environmental impacts were investigated by a team of Survey and State Museum scientists under the leadership of Dr. David Gross of the Geological Survey.

The State Museum looked at archaeological and paleontological resources in the area, generating maps of site location probability. Most sites can be avoided, and if that is not possible, excavated and properly recorded.

The **Natural History Survey** examined soil maps, identified endangered or threatened species and inventoried natural areas. The largest natural area near the site, of course, is the one located in the center of the Fermilab ring.

Flood hazard areas were examined by the **Water Survey.** Maps delineating 100 year floodplains will facilitate the best siting of access shafts and buildings in the ring.

Armed with this data, the Geological Survey recently published "The SSC Environmental Screening Atlas," a color atlas that describes what the scientists know about the proposed SSC site.

Dr. David Gross summed up the state of the State of Illinois' knowledge: "The SSC landscape is well-known. We have the data needed and the Department of Energy and Natural Resources has the expertise to use it."

Dr. John Kempton is Senior Geologist at the Illinois Geological Survey and is leader of the SSC Geological Task Force. Dr. David Gross is Geologist and Head of the Environmental Studies and Assessment Section at the Illinois Geological Survey and leader of the SSC Environmental Screening Task Force. They have been working on the SSC project for four years.

The SSC Timetable

SSC proposals from states due to U.S. DOE	September, 1987
U.S. DOE review of proposals to see which are "responsive"	September, 1987
DOE sends responsive proposals to independent panel of the National Academy of Sciences/National Academy of Engineers	October, 1987
NAS/NAE panel reviews proposals and returns "short list" of qualified state sites (possibly 6) to DOE	December 1, 1987
DOE announces 6 finalists and asks for additional data, especially environmental data	December, 1987
Site winner is announced pending satisfactory environmental impact statement (EIS)	July 1, 1988
Single EIS should be completed with state's reasonable alternatives, public hearings held	August 1, 1988
Confirmation of site winner	January, 1989
Collider construction	February, 1989 —
Project completion	1996

The Erosion of History at Gettysburg

by William A. Rooney

The torrent of battle washed over the small town of Gettysburg on the first three days of July, 1863, leaving 6,000 dead and 21,000 wounded and dying. Now the scene is a gentle green countryside that would certainly have been endorsed by Illinois poet Carl Sandburg's poem **Grass:** "Shovel them under and let me work." The soft green hills are dotted with markers of every kind — brigade markers, memorials, and monuments to the Civil War heroes who fought there. Unhappily, these monuments are suffering.

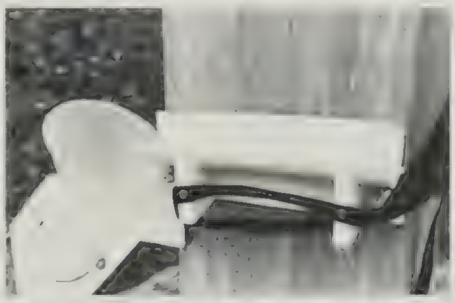
On the 3,500 acres of the Gettysburg National Military Park, there are 1,320 monuments, plaques, markers, statues and memorials. They are bronze, marble and various types of stone. Some of them were erected on this historic battlefield almost immediately after the battle ended on July 3, 1863. Others have been installed as recently as this year. All are subject to deterioration from wet and dry deposition of airborne acidic pollutants.

Donald A. Dolske of the Atmospheric Chemistry Section of the Illinois Water (IWS) has undertaken a study for the National Park Service to provide detailed information on the chemistry of the rainfall and its effects on Park monuments. The study also is looking at pollutant deposits that accumulate on monuments during the periods between rains. Dolske is seeking an answer to the question of what these pollutant accumulations do to marble and bronze when combined with acidic rain. This is particularly critical since the Gettysburg battlefield is located in southeastern Pennsylvania, an area which receives the most acidic rainfall in the country.

Deterioration of the stone and metal of the Gettysburg monuments is not new. The burning of coal and wood produced pollutants which damaged monuments soon after they were first set in place shortly after the battle. In charge of the site in the 1880's, U.S Army authorities noted the deterioration of the marble, and an order was issued stating that future monuments had to be made of granite.

Tom Rice

North Carolina monument to her Confederate soldiers. This is on Confederate line on Seminary Ridge at Gettysburg. Monument is by noted sculptor Gutzon Borglum, who with his son sculpted figures on Mount Rushmore.


Illinois Water Survey

Runoff collector on Gettysburg monument

Dolske has designed a research project to study eight of the battle field's monuments. Four of the monuments are bronze — three brigade markers of "U.S. Standard Bronze" and a bust of General C.T. Collins. Four marble monuments are also being studied. Two are obelisks and two are figures on the Soldiers National Monument. More monument samples will be selected for study as the research continues. As might be expected, because of the swirling nature of the battle, monuments are at many elevations and face virtually every point of the compass, giving them a host of different exposures to wind, sun and rain.

The IWS researcher has designed runoff collectors which channel rain that has reacted with the surface of the monuments. Each collection bottle is cleaned and flushed before it is installed. Classic sculpture almost always incorporates some unnoticed pathways for water to run off. Very few such sculptures are designed in a way that allows water to pool unless so intended. Accordingly, water flows off garment folds and body parts. This simplifies the placement of some runoff collectors. As a control, additional rain collectors are set up to catch ambient precipitation.

All of the collectors are in place during a rain event. Immediately after rainfall, samples are removed, sealed and shipped to the Water Survey in Champaign for processing and analysis. Once the samples have been collecte the collection bottles are removed, cleaned and stored until the next rainstorm appears on the horizon. When the forecast is for rain, the instruments are brought out and put in place on the study monuments. If the rain does not begin within twelve hours, the cleaning process is repeated.

Up to December 1986, seven sets of runoff samples, only about half the number expected, had been collected and sent to IWS labs for processing. An extended dry period at the battlefield during the summer contributed to the small number of samples. Although extensive analysis of these samples has been undertaken and some interesting results recorded, final conclusions have not been reached because of the relatively small data base. Refinement of rainwater collection methods continues.

IWS has been aided in this project by the National Atmospheric Deposition Program network, which has several sites in southeastern Pennsylvania. Penn State University operates an acid rain monitoring station at the Eisenhower National Historic Site adjacent to the Park. National Park staff and volunteer site operators have also contributed to the study.

The ultimate findings of the research will contribute to a greater worldwide understanding of what is happening to outdoor works of art. The National Park Service staff at Gettysburg, in its visual assessment of the monuments' deterioration, says that damage has become much worse recently. An assessment like this may be inaccurate, however, for several reasons. One is that deterioration may have been going on in ways unnoticeable to the human eye for many years. Then the damage bursts into the open and becomes clearly visible.

Rain falling from the trees themselves may be a contributing factor to the deterioration of the monuments.

Consideration must also be given to the change in foliage that has occurred in the Park since the days of the battle 124 years ago. The trees and shrubs that grew on the battlefield then are in no way comparable in size to the flora growing on the site now. The careful nurturing of the trees on the battlefield is a tribute to the care that has been given to "this hallowed ground" in the last century and a quarter. Now those trees may have something else to say about the condition of the monuments.

Rain falling from the trees themselves may be a contributing factor to the deterioration of the monuments. Acid rain leaches organic materials from battlefield foliage. These organic materials provide nutrients for microorganisms which grow upon the surfaces of the monuments and discolor their surface. This is particularly a problem with monuments made of stone.

Finally, the sad fact is that in recent years vandalism is causing as much or more damage to the battlefield's monuments as acid rain or other natural forces. So extensive has vandalism become that the National Park Service in Gettysburg is launching an educational program to combat this form of damage.

Donald A. Dolske is a research scientist with the Atmosphpheric Chemistry section of the Illinois Water Survey and has been with the Survey for six years.

William Rooney is a former advertising executive and communications consultant. His lifelong interest in architecture prompted him to author a book, ***Architectural Ornamentation in Chicago,*** *which was published in 1984.*

Gettysburg National Military Park, December 1986

Don Dolske

The Reincarnation of the I & M

by James Krohe, Jr.

In its heyday in the mid-1800s, it ranked second in importance only to the Erie Canal among commercial waterways in the U.S. But the heyday of the Illinois and Michigan Canal, which connected the bustling docks of Chicago with river ports along the Illinois and Mississippi, didn't last long. The railroads quickly took over much of the canal traffic in both freight and passengers. Commercial operations were halted altogether in 1933, and the canal — 60 feet wide at the surface along most of its length, flanked on both sides by levees and towpaths built in its 270-foot right-of-way — was abandoned.

The I & M Canal has lain largely derelict in the half-century since its official closing. Most of the upstream reach of the canal, between its original terminus in the Bridgeport district of Chicago and the suburb of Summit, has carried commuters rather than canal boats since the Stevenson Expressway (I-55) was built on its right-of-way. The rest of the canal's more than 96-mile length — from Lockport past Ottawa and Joliet to its western terminus at LaSalle — is a canal in name only.

The problem is that parts of the canal sometimes have no water in them at all. Land use and drainage patterns along the canal have been permanently altered.

Today, the canal has a chance for a second life. The recreational potential of the canal, with its many miles of water and shaded towpaths so near the state's metropolitan center, was recognized in the 1940s. In the early 1970s, the Illinois Department of Conservation prepared a master plan for the revitalization of various downstream reaches of the canal as sites for hiking, biking, camping, and tourism; more recently, the federal government designated the surviving stretches of the canal as a unique Natural Heritage Corridor. Public parks and trails which already dot the canal have been augmented by private restoration projects. Chief among these is the restoration of the supply depot and warehouse near the old Lock #1 in Lockport. Dedicated in the spring of 1987, the Gaylord building houses a restaurant, a DOC visitors center, and a gallery of the Illinois State Museum.

Much of the revitalized canal's future, like its past, depends on boating, albeit of a kind different from the old cargo craft. The use of all or parts of the canal as a recreational waterway capable of carrying canoes or small motorcraft has been a dream of canal boosters for years. With that end in mind, DOC in 1986 proposed a cooperative study with the Illinois State Water Survey which would examine the present hydrology of the basin, more specifically, the hydraulics of the flow within the reach between Locks 1 and 2 near Lockport. The aim of the study is to find ways to maintain a minimum of water level there for recreational use, at least during the warmer months.

That study has not yet been funded. But previous studies by SWS experts on other reaches of the canal suggest some of the problems such a project might face. When it was completed in 1848, the canal carried six feet of water. Nani Bhowmik, a public engineer with the SWS Surface Water Section who has made preliminary investigations of the canal's hydrology, explains. "The old barges needed 4 to 6 feet of water, but now we probably wouldn't need that much."

The problem is that parts of the canal sometimes have no water in them at all. Land use and drainage patterns along the canal have been permanently altered. "There used to be surface drainage into the canal which helped maintain its water level," explains Bhowmik. That water was delivered in part via feeder canals which drew upon the nearby Fox, Calumet, and Kankakee rivers. That system was far from perfect even when it was new. (An extended drought in 1853 nearly shut down traffic.) Today it works hardly at all. Intensive farming has boosted the flow of sediments into the canal, for example. "I suspect that 75 percent of the original inlets are full of sand and sediments," Bhowmik says. "Water is not coming into the canal like it used to." The result is standing, stagnant water in some places, and no water at all in others.

Restoring water to the canal would be fairly simple. Bhowmik suggests the possibility of pumping water from underground reservoirs along the Illinois River, "induced infiltration, in effect." Restoring the canal's water-carrying capacity will be harder. The same inflows of silt which clogged canal inlets have clogged the canal itself. Sedimentation is especially troublesome, since these days the canal's main cargo is water. The canal serves as a storm water drainage system. The old system of 17 locks retarded the flow of canal water, creating a series of stepladder-like pools descending to the Illinois. Those locks are dilapidated or destroyed. "Basically, there's a creek running through the canal," explains John Comerio of DOC's planning staff. Sedimentation of the canal bottom and the poor repair of canal walls in some reaches (near the town of Seneca, for example) have meant that storm water quickly fills, then spills over the canal banks, flooding adjacent property.

Dredging clogged canal sections and repairing breached banks would increase the flow of flood water through the canal. Damming the canal to create a stable water pool for boating would obstruct that flow. Instead of being clogged with mud, such a pool would be in effect clogged with water. Its capacity to accommodate additional water thus reduced, such sections would also quickly overtop their banks during storms. Releasing excess water would protect property adjacent to the pool from flooding, but only by increasing the risk of flooding vulnerable areas downstream.

A flow control system capable of serving both boating and flood protection will require some complex engineering. Says DOC's Comerio, "It's going to be tricky and it's going to be costly. But we don't want to do something on the state-owned part of the canal which might impact local communities."

Detailed answers to this engineering dilemma must await further study. Bhowmik is confident those answers can be found. He foresees a revitalized Illinois and Michigan Canal which will rival the canals of Europe. "There's a tremendous amount of work to be done," Bhowmik concedes. "But if it is done properly, it will be a very natural looking canal."

Nani Bhowmik, Principal Scientist with the Surface Water Section of the State Water Survey, holds a Ph.D. in civil engineering. An 18-year veteran of the Survey, he specializes in the impact of sedimentation on lakes and rivers.

Illinois Water Survey

A lock needing some immediate repair.

Illinois Water Survey

Gaylord Building in Lockport under reconstruction.

Raiders of the Lost Worts

Ken Robertson

Dog-eared violet
(Erythronium mesochoreum)

"Botanical detective work," is the phrase Mary Kay Solecki uses to describe the work now underway by her and five fellow scientists of the Natural History Survey (NHS) to find out whether more than 80 species of rare plants recognized as rare in Illinois a decade ago still survive.

The search takes plant hunters from the tops of river bluffs to the bottoms of smelly bogs, and along the way they must contend with chiggers, mud, and the sometimes vague geographical references left by their predecessors. Time is a factor too. The project began in January, 1987 and will continue only through the current growing season. Researchers typically have only two or three days to locate each plant population on their list, a process which often is like finding a needle in a hayfield.

The hunt has been undertaken as part of an effort to update the official list of plant species which are endangered and threatened in Illinois, first published in 1980. The rare plants which survived to be included on that first list often did so because they thrive in out-of-the way corners of the state, which makes finding them difficult. A typical search begins not in the field but in the herbarium. The locations of past collections of each species are noted, and subsequent field explorations are made to confirm their continued presence. Extant populations of the rarer species may consist of as few as a dozen individual plants, although Solecki found a thriving population of some 7,000 *Tradescantia bracteata*, or prairie spiderwort, along one old railroad track in Greene County. Thriving but still endangered; the site is unsecured, and those plants could be destroyed by a bulldozer weed killer in minutes.

Many Illinoisans might find it odd that the counties which harbor the highest number of endangered and threatened species are among the most heavily urbanized in the state. Cook County, for instance, is home to 135 species on the Illinois list, and Lake County 116. The reason is that the northeastern counties (and to some extent counties of the far southern reaches of the state) boasted a richer than-average number of species to begin with. "Diversity of habitat is the reason," explains Kenneth Robertson, botanist with the NHS Section on Botany and Plant Pathology.

"In the northeastern counties you've got sand prairies and beach areas, alkaline fens and acid bogs, exposed glacial moraines, gravel prairies, and savannah. In the southern part of the state you've got sandstone outcrops along the Mississippi, for example, and southern-type coastal cypress swamps. Most of the rest of the state was prairie, and while prairies are very interesting, they don't have that many species."

Those former prairies have also been especially vulnerable to the destructive impact of agriculture. Plowing, grazing, and herbicide use has meant that many farm counties count as few as five endangered or threatened plant species within their borders. Indeed, in terms of their botanical integrity at any rate, many of Illinois' rural counties are more "developed" than its urban and suburban ones.

The comprehensiveness of any such listing depends on the intensity of the collection efforts by field botanists. Even the 128 years the NHS scientists have spent trudging the fields and forests of Illinois has not been time enough to visit every one of its nearly 36 million acres. "The conventional wisdom is that Illinois has been heavily botanized," says Solecki, an Assistant Research Biologist with the Section of Faunistics and Insect Identification. But rare plant species are being discovered — and rediscovered — all the time, at a rate of roughly ten a year. Some of these species were not known to occur in Illinois. (*Erythronium mesochoreum*, or dog-eared violet, first discovered by Robertson in Macoupin County in 1981, is one such plant.) Others were found in new locales after having been thought extirpated: the *Paspalum dissectum*, or bead grass, found by NHS botanist Eric Ulaszek in Williamson County; was last collected in the state in 1893

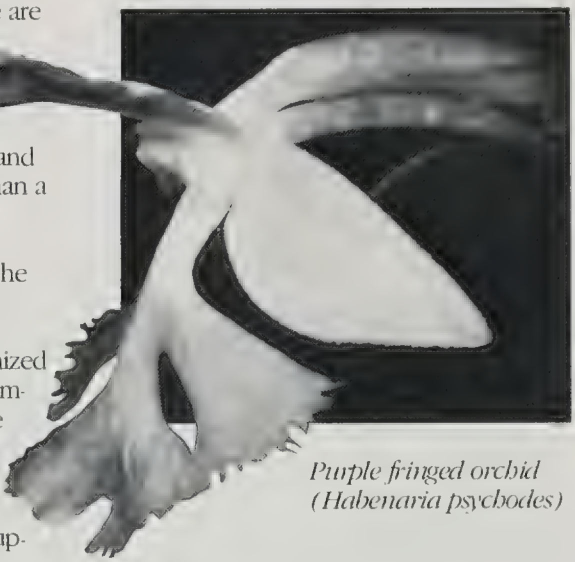
Given the hopelessness of botanizing a state the size of Illinois, compilers of the endangered plant list relied on herbarium records for information about the incidence of many rare plants. The method has its uncertainties, as Susan Lauzon, Endangered Species Praogram Coordinator for the Illinois Department of Conservation explains. "If a plant hasn't been reported recently, is it because it has suffered a decline in population? Or is it just that people are not collecting it?" The field investigations required by the updating will help answer such questions.

The state's list of endangered and threatened plant species is more than a botanical curiosity. Both state and federal laws (there is a federal endangered list as well) authorize the redesign, even the cancellation of certain construction projects which might imperil populations of recognized rare species. The Illinois list was compiled under the requirements of the state's 1972 Endangered Species Protection Act, and included 312 endangered species and another 52 thought to be threatened. The updating now underway is the first required under a 1986 amendment to that act which requires review and revision of the list every five years.

Armed with official endangered status, even a tiny plant such as the purple fringed orchid *(Habernaria psychodes)* can stop a bulldozer. With projects costing millions of dollars potentially at stake, says Robertson, "It's not good to have names on the list that we can't legally justify."

Recommendations about additions to or deletions from the state's official endangered plant species list are made by the advisory committee on plants to the Illinois Endangered Species Protection Board, which makes the final decision. Robertson is a member of that advisory committee. "Things we can't find this year," he says of the short list of species to be confirmed, "the committee will have to decide on a species-by-species basis."

Given the pace of habitat destruction, plant species are less likely to be taken off the list because they are no longer endangered than because they are no longer there. Robertson estimates that as few as one-fourth of the species being sought during this season's updating will be found to be still present in the state. "If we don't find them at their historical locations," notes Solecki, "there's a good chance that they must be considered extirpated in Illinois." Robertson offers an example: "Say a plant has been found in the past only in the wet prairie of Champaign County, and we know that all the natural wet prairie in Champaign County has been destroyed. We would have to assume that the plant has probably been destroyed too."


Elvin Warrick

Purple fringed orchid (Habenaria psychodes)

Other populations of species thought lost might persist unobserved at other Illinois sites. Solecki offers the example of a cinquefoil which was collected by Survey staff in the early 1970s from a half-mile stretch of the Mississippi in Union County. A recent return trip failed to find it. "I could have expanded my search up and down the whole Illinois shore of the Missisippi," says Solecki, explaining that similar habitat tend to harbor similar communities of plants. "But I just don't have the time."

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Armed with official endangered status, even a tiny plant such as the purple fringed orchid can stop a bulldozer.

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Why bother protecting such species at all? Species which are rare in Illinois are (with few exceptions) not rare in other parts of the U.S. As John Taft, Assistant Research Biologist with the Section on Botany and Plant Pathology, explains, "Most endangered species in Illinois are plentiful elsewhere. We have just a handful of near-endemics." At issue is not their extinction, in short, but their extirpation from that part of their natural ranges which includes Illinois.

However, Taft and his colleagues agree that while nature as a whole might not lose from such disappearances, Illinois certainly would. The beauty of many endangered plants (the Illinois list included no fewer than 17 members of the orchid family, for example) is one argument for their preservation. So is the fact that such plants still have much to teach us. The native plant communities of which they are a part provide ecological benchmarks by which environmental change may be measured. And the plants themselves could provide everything from new medicines to genes capable of improving the disease resistance of crops.

Recording the existence of endangered species is a necessary first step toward not only their preservation but ours. "In terms of ecology," warns Taft, "we're leaving a far more sterile environment for the future to exist in."

Dr. Kenneth R. Robertson is a Botanist and Professional Scientist in the Botany and Plant Pathology Section at the Illinois Natural History Survey, and holds an affiliate appointment with the Department of Plant Biology at the University of Illinois.

Mary Kay Solecki is Assistant Research Biologist with the Section of Faunistics and Insect Indenification. John Taft is Assistant Research Biologist with the Section of Botany and Plant Pathology. Other investigators on the project are Philip Burton, Technical Research Biologist, and David Ketzner, Assistant Research Biologist, both with the botany section, and Eric Ulaszek, Assistant Research Biologist with the faunistics section.

Farming Fish

by James Krohe Jr.

If predictions by scientists of the Natural History Survey's Aquatic Biology Section prove correct, the term "farm pond" will have a new and profitable meaning as Illinois agriculture enters its third century. Aquaculture is the production of food animals such as fish and crustaceans in ponds. In parts of the country aquaculture already is a sizeable industry supplying restaurants with such staples of the menu as catfish and rainbow trout. Illinoisans eat a lot of fish and have a lot of ponds - more than 85,000 of them on farms alone. Why not use one to produce the other?

That question was asked more than a decade ago by researchers such as Dr. Homer Buck (recently retired) at the Sam A. Parr Fisheries Research Center, an NHS field station near Kinmundy. The idea of fish polyculture was then new to Illinois, but the Chinese had been doing it for centuries. The technique requires creation of a balanced food chain in the pond, with organic matter such as manure supplied as food for the bottom of the chain and food fish such as carp harvested from the top.

The carp family is especially valuable in such systems because of the versatility of their appetites. Some species feed on phytoplankton, others on algae, others on aquatic plants. "The Chinese may use eight different kinds of carp," explains Robert Gorden, head of the Aquatic Biology section, "each feeding at a different trophic level of the food chain." Early experiments in Illinois also grew carp, in combination with Malaysian prawns, using raw manure as the feed source. (Illinois hogs are walking aquaculture feed factories.)

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Illinoisans eat a lot of fish and have a lot of ponds - more than 85,000 of them on farms alone. Why not use one to produce the other?

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Says Gorden, "We're encouraged that this type of aquaculture is feasible in terms of productivity and safety. We can produce 3-4,000 pounds of carp per acre of pond per year in Illinois" - good yields considering that Illinois winters make the fish-growing season shorter than in the South. However, adds Gorden, "We are not encouraged in terms of markets and economic feasibility." Carp and prawn are popular foods in the Orient, but they are not to the taste of the typical Midwesterner, who associates the former with the common carp which infests the region's streams and lakes. (There is a growing market for fresh carp among Illinois' Asian population, especially in Chicago; for the moment that demand is being met by carp taken from rivers by commercial fishermen.) Soybeans are another nutritious food which in their original form leave a bad taste in most people's mouths; as was the case with the soybean, the commercial future of carp may depend on finding ways to use it as an ingredient in processed food products such as generic "fish sticks

Natural History Survey

Collecting fish in the weir.

Can species more appealing to the U.S. palate also be raised by Illinois aquaculturists? Catfish is the nation's top aquaculture product, but cool-water fish such as bass and crappie have commercial potential as well; unlike the common carp they enjoy what one Kinmundy staffer politely describes as "a good reputation" among consumers. So do crayfish, at least among consumers who've tried them. "Crayfish are just as good tasting as shrimp," Gorden says. "They offer a much better market than carp," both as a table delicacy (which sells fresh for as much as $9 a pound) and as fish bait. Proof can be seen in Louisiana and Texas, where commercial crayfish ponds cover tens of thousands of acres.

Crayfish in the South are typically grown in monoculture systems from which they are the sole food animal harvested. "In a small setting such as a farm, polyculture has many advantages," explains Paul Brown, a Texan who recently brought knowledge of the commercial catfish industry to the staff at Kinmundy. "But for production on an industry scale, I'm a proponent of monoculture." Catfish are raised in monoculture ponds. However, it is widely assumed that Illinois weather makes cat fish production uneconomical because of shorter growing seasons and problems with oxygen depletion in iced-over ponds. Cool-water species are naturally more suited to the local climate. Hybrids of both the striped bass and the crappie are especially promising. Both have been raised in test ponds at Kinmundy as game fish; Brown plans to test their suitability for more intensive production as food fish.

For the moment, what people eat is less interesting a question for Survey researchers than what fish and crustaceans eat. As Brown explains, "Feed costs in pond culture comprise at least 50 percent of production costs." Finding a high-efficiency low-cost feed for each animal is crucial to the economics of any future Illinois aquaculture industry. Carp, for instance, do well in manure-fed polyculture ponds, but as Gorden explains, "Not all animals are going to eat manures." Catfish thrive on relatively inexpensive commercial feeds made from plants (chiefly corn and soybeans) but such feeds do not provide other species with enough digestible protein. What feeds might? That isn't clear. Brown is preparing feeding trials of the new bass and crappie hybrids to find out, because, "We don't know the optimum feed for the critters yet."

Crayfish are less finicky, and indeed in southern ponds often are left to feed on naturally occurring aquatic plants such as alligator weed. Gorden is conducting tests of an innovative process which converts wheat straw from a low-protein waste into a high-protein feed source. Straw is treated with a solution of hydrogen peroxide and sodium peroxide, then inoculated with different consortia of bacteria.

The process breaks down the tough, fibrous cellulosic fibers, making the the straw more digestible. Tests on ruminant animals such as beef cattle have had promising results. The first phase of tests of such processed straw as aquaculture feeds monitored changes over a 7-day period in caloric value and carbohydrate and protein content of various batches of straw. The next phase will be actual feeding trials, beginning with test animals in aquariums, followed by experiments in largers tanks and ultimately full-sized ponds.

Gorden has proposed a novel pilot project in which two or more of the more than sixty "borrow pits" or roadside ponds owned by the Illinois Department of Transportation might be used to demonstrate the pond culture of various species. In one proposed test, stripe bass hybrids, crayfish, and grass carp (which feed on algae and other small aquatic plants) would be raised in polyculture systems; in another, bass would be raised with monoculture methods, including confinement of fish in suspended cages - fish corrals - to make sampling and harvest easier. Experts in meat processing and farm marketing and farm management from the University of Illinois' College of Agriculture would assist Survey staff in testing production techniques, identifying parts of the state where aquaculture might be economically optimum, devising end products with maximum commercial potential, and so on.

Much remains to be learned. But Gorden enthusiastically describes aquaculture as an "industry ready for growth" in Illinois. Brown agrees. "It's up to the people of this state," he says. "If they want to raise fish up here, they can."

Robert W. Gorden is Aquatic Biologist and Head of the Section of Aquatic Biology of the Natural History Survey. Holder of a Ph.D. in Microbial Ecology, his principal interest is in the function of heterotrophic bacteria in aquatic ecologies. Paul Brown is an Assistant Professional Scientist with the Survey, working at the Sam A. Parr fish nursery. Trained at Texas A & M University, his principal area of interest is the nutrition of aquatic animals. Other staff members contributing to the Survey's aquaculture research are Dr. Sherry Lewis and Dr. Homer Buck.

On Stilts

It was a cruel fate that wrapped one of geology's greatest gifts to Illinois - its rich beds of coal - in its equally rich farm soils. The mining of coal from deposits near the surface has effects (in the short term at least) on farmland. But underground mining affects the surface too. The sinking, or subsidence, of the surface which occurs when a coal seam which once helped support it is removed can be as much as three to five feet, more than enough to disrupt surface drainage or destroy a house foundation.

Since most of Illinois' coal lies beneath farmable land, the potential impact of subsidence from both past and future mining on agricultural productivity is worrisome. More than 700,000 acres of Illinois have already been undermined, and the total grows daily. Farmers have an obvious interest in the problem. So does the coal industry, which must comply with stringent state and federal regulations mandating the reclamation of prime farmland disturbed by mining, and the Illinois Department of Mines and Minerals, which has major responsibility for enforcing those regulations.

To learn more about subsidence how it happens and where, as well as how to predict it - the Illinois Mine Subsidence Research Program, or IMSRP, was established in 1985. Funded jointly by the U.S. Bureau of Mines and the Illinois Coal Development Board, the program is a multiyear research effort directed by Geological Survey staff in collaboration with fellow scientists from Southern Illinois University and the University of Illinois, acting under the guidance of technical and policy committees drawn from the state's industry, agriculture, and regulatory communities.

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More than a thousand square miles of Illinois, in effect, is standing on stilts.

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Paul B. DuMontelle, Illinois Geological Survey (IGS) engineering geologist, is director of the program DuMontelle points out that much is already known about mine subsidence (A computerized bibliography assembled in the early stages of the project contains 2,500 entries). The problem is that much of that knowledge concerns states whose

Paul DuMontelle

Ponds caused by longwall mining will be filled in and the farm land restored to original production.

geologic conditions are very different from Illinois'. The way coal is mined is just as crucial as where it is mined. Until very recently most underground mining in Illinois was done using "room and pillar" methods, in which substantial amounts of the coal seam are left intact in the form of bulky pillars. These pillars support the mine roof and thus the overburden of bedrock, glacial till, loess, clays, and shale which lie in layers atop that roof in depths from a few dozen to several hundred feet. More than a thousand square miles of Illinois, in effect, is standing on stilts.

Done carefully, room and pillar methods leave behind a relatively stable support for the surface above. "Very little subsidence would be expected to take place," says DuMontelle. Indeed, many abandoned underground works haven't budged in a century. But even well-built mine works can and do give way in places. Mining alters a subsurface geology which has been intact for millions of years. Materials which comprise the floors of many mines, for example, derive their strength from being stressed under the confinement of material arrayed above them; removing that material relieves that stress and floors are thus weakened along the edges of supporting coal pillars. As the IGS staff put it in a 1981 "Environmental Geology Notes" about subsidence, "If any coal has been removed, subsidence will always be a possibility."

DuMontelle notes that there is yet no standard system by which the collaspe of room and pillar works can be predicted. "The characteristics of the floor and the roof, even the coal itself, may change within a few hundred yards." Interestingly, sizeable subsidence usually follows the collapse of a mine floor, not its roof. Illinois mines tend to have solid "tops" of limestone. But mine pillars typically rest on an underclay whose deformability under the effects of moisture or stress allows the roof to sink, intact, into the floor.

Chemical reactions (water is a destructive force in an abandoned mine), vibrations from blasting, the geometry of the pillar, even imperfections in the coal itself also affect the strength of the support system. One of the aims of the program is to collect data on the structural qualities of floor materials from actual mines so as to assemble a predictive model for limited extraction mines which takes into account relationships between material, moisture, and other factors. Data collection of this sort can be dangerous; many old mines are flooded, or filled with poisonous and explosive gases, so researchers resort to poking TV cameras down drill holes to get a peek.

The stability of a room and pillar system is purchased at a high price in wasted coal. Roughly 50 percent of the coal in the actual excavated areas or panels is left behind in a room and pillar mine, and recovery rates from the mine as a whole may be as low as 35 percent. Using more modern high extraction techniques such as longwall mining, all the coal in a panel can be removed.

Such methods make possible a more complete recovery of an exploitable resource, which is a boost for conservation. "The more coal you can get from one acre," DuMontelle explains, "the fewer acres you need to mine." And the fewer acres of surface land which need to be exposed to subsidence damage. The unsupported roof of a fully excavated longwall panel is allowed to collapse as part of what amounts to a planned subsidence. (The process begins within hours after the coal seam is removed, and usually ends in a few weeks, although it can take as long as two years.)

"Coal companies are doing some amazing things," explains DuMontelle. In places in Southern Illinois one can see houses sitting on jacks, waiting until they can be repositioned on new foundations after an expected subsidence occurs.

While subsidence from room and pillar mining is unintended and thus unpredictable, that from high extraction methods is deliberate and predictable. "You know you're going to affect the surface," explains DuMontelle of longwall mining and its kin. "The question is, how much?"

The whether and the when of subsidence are functions of mining method and underground geology, but the how is largely a matter of distance between mine and surface. The failure of the roofs of shallow mines (less than 200 feet) usually creates pit subsidence. Pits are straight-sided holes which appear suddenly, sometimes as wide as 40 feet (although most are barely half that) and 6 to 8 feet deep.

The collapse or sinkage of pillars in deeper mines causes sag subsidence. A sag is typically shallower than a pit subsidence but affects a much wider area, often an entire panel covering several acres. The ground separates at the edges of the sag and compresses in the middle from the pressure of slumping soil. Sags thus create both tensile and compression forces at the surface which subject structures to complex shearing and bending strains.

The potential subsidence damage to structures, including not just buildings but roads and utility systems, are obvious. Subsidence poses threats to the land itself which are less vivid but still quite real. The depressions formed by sags in farm fields, for instance, collect water and form shallow ponds after rains which hamper crops. Agronomists working with the IMSRP are studying the effects of such wetting on corn yields affected by previous high extraction mining. The preliminary results show average annual per acre yield reductions using the longwall method of roughly 4 percent, with losses of 9 percent for the longwall method in wetter years. Subsurface drainage can be disturbed too; a common effect of subsidence in Eastern coal states is drought, as shallow aquifers are drained away.

Some major Central Illinois aquifers, such as the Mahomet Valley aquifer, lie above mineable coal seams. DuMontelle confesses, "Frankly, we don't know what happens when an aquifer is subsided." It could be contaminated by silts released by ground movement; if such movements open pore spaces in the water-bearing formations, aquifers might actually be improved by increasing their capacity and pumpability.

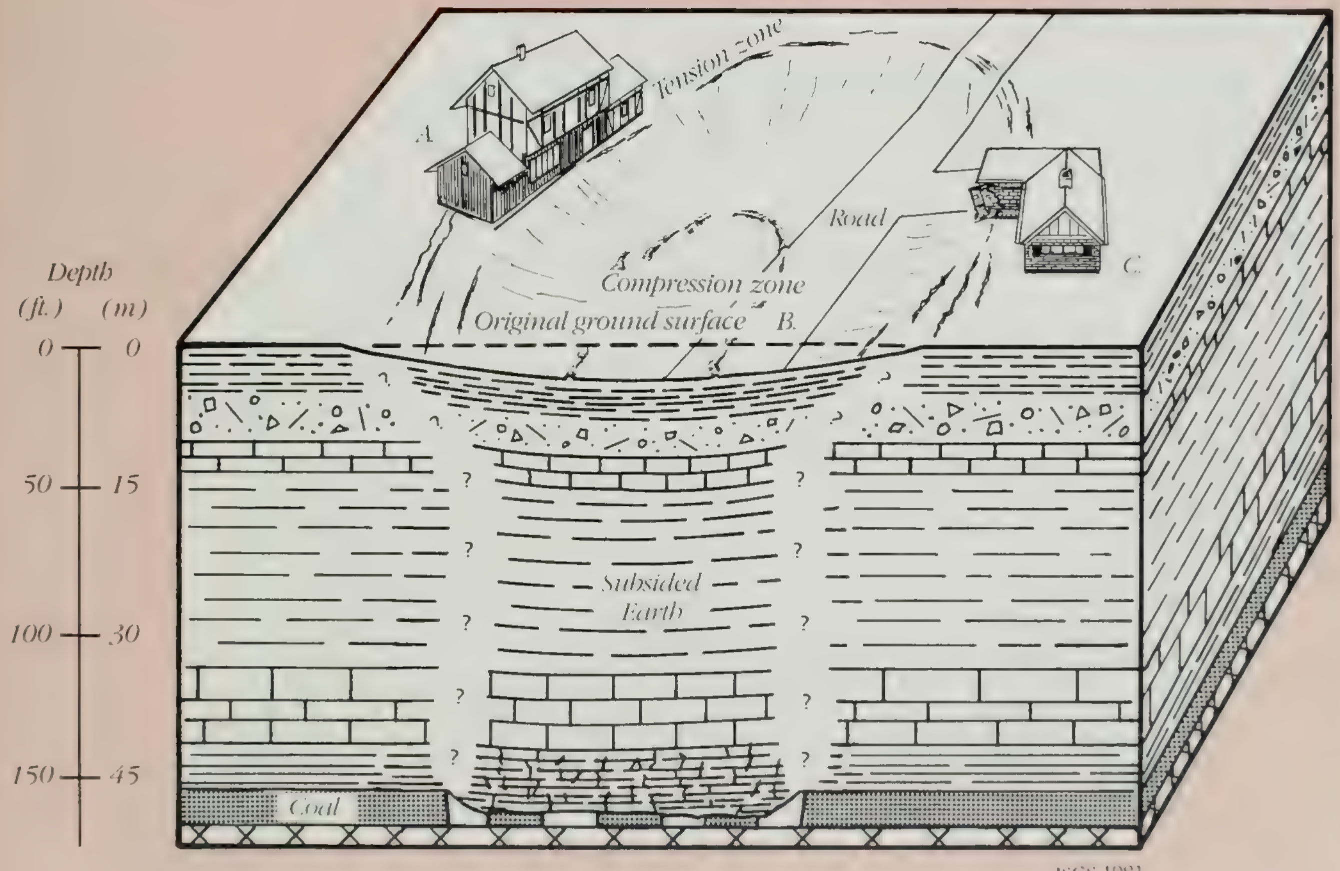
To some extent, the surface effects of subsidence can be mitigated in advance. "Coal companies are doing some amazing things," explains DuMontelle. In places in Southern Illinois one can see houses sitting on jacks, waiting until they can be repositioned on new foundations after an expected subisdence occurs. One major oil pipeline has been subsided three times without spilling a drop.

The predictability of subsidence from high extraction mining makes the planning of such mitigative efforts easier. Mitigating subsidence impacts over farm fields stretching across many acres, however, is easier to plan than to pull off. Surface property boundaries seldom coincide with the boundaries of mines below them. And if barrier pillars which separate underground panels are left standing, subsidence can leave the surface crisscrossed with small dikes. DuMontelle suggests that the way to minimize the surface effects of subsidence is to do more of it rather than less - by removing barrier pillars, for example, so that subsidence is uniform over a larger area.

The answers to the questions being asked by the subsidence research program are crucial to the economic health of the Illinois coal industry. "Illinois companies are shifting rapidly to longwall methods to compete," says the IMSRP director. "If coal is to continue to be an economically viable commodity in Illinois, it will have to come from longwall mines."

Paul DuMontelle, Geologist, is head of the Earth Hazards and Engineering Geology Section; his research interests include mine subsidence, earthquakes, and landslides. Technical Manager of the Mine Subsidence Research Program is Robert A. Bauer. An Engineering Geologist in the same section, Bauer is a specialist in rock mechanics.

Block diagram of a typical sag subsidence event:



ISGS 1981

A. Wooden frame house in tension zone. Foundation has pulled apart and dropped away from the superstructure in one corner.
B. Road in compression zone. Asphalt has buckled.
C. Brick house in tension zone. Walls, ceilings, and floors have cracked.

SURVEYING

ILLINOIS

GEOGRAMS

Earthquake Does Not Affect SSC Site

The earthquake that occurred June 10, 1987, centered near Lawrenceville in southern Illinois, does not affect the State of Illinois' bid for the Superconducting Super Collider (SSC). In northeastern Illinois, the proposed site for the SSC, the earthquake registered between III (slight) and IV (moderate) on the Modified Mercalli (MM) Intensity Scale, according to Dr. Paul C. Heigold, Illinois State Geological Survey lead geophysicist. This seismic event equates to 5.0 on the Richter Scale.

Unlike most other states, Illinois is proposing to build the SSC tunnel in solid bedrock, 300 to 500 feet below the surface. Tunnels are far less susceptible to damage from shaking than aboveground structures. In a study of 71 case histories, Dr. Charles Dowding of Northwestern University found no damage (defined as cracking or falling of rocks) in tunnels below the ground surface where Modified Mercalli intensities reached as high as VIII.

Map Series Completed

Plans are being made by the Illinois State Geological Survey (ISGS) and the Illinois Mapping Advisory Committee (IMAC) to commemorate the completion of 7.5-minute, 1:24,000-scale map coverage of Illinois. Twenty-four recently published topographic maps of an area in east-central Illinos round out the 1,071-map series, a cooperative effort of the ISGS and the U.S. Geological Survey.

Features include drainage and an accurate depiction of surface relief by means of contour lines and all major cultural entities, such as cities, towns, villages, or other incorporated areas; farmsteads; railroads, highways, roads and trails; power-transmission lines; pipelines; oil wells; oil tanks; water tanks; streams and lakes, dams, bridges, mines, quarries and gravel pits; campgrounds; woodland areas; named natural features; township and country homesteaders in the 1800s. For orientation, latitude and longitude expressed in degrees, minutes and seconds, as well as grid systems in both meters and feet are presented.

Priced at $3.20 each, including shipping and handling charges for Fourth Class mail or $6.20 for First Class mail/United Parcel Service, these maps can be ordered by writing the ISGS Information Office, 615 E. Peabody Dr., Champaign, IL 61820, specifying the names and series of maps desired. That information can be obtained from the Index to Topographic Maps of Illinois, a publication of ISGS, which will be supplied free of charge.

New Maps Show Geologic Framework

The Illinois Geological Survey has published multicolored, 7.5-minute geologic maps of the Shawneetown, Equality and Rudement Quadrangles. These are the first quadrangle maps the ISGS has published since 1965, and the first of a planned sequence of 15 such maps.

The sequence, which will provide basic information on the geologic framework of southern Illinois, is being produced by the Survey in cooperation with the U.S. Geological Survey, under the auspices of the Cooperative Geologic Mapping Program (COGEOMAP). The maps provide a detailed portrayal of the Shawneetown Fault Zone, a major east-west trending geologic fault zone that extends from just south of Old Shawneetown, Illinois, westward through all three quadrangles.

Geology of the region is revealed in new detail, useful in mineral-resource exploration and land-use planning. Each map is presented with a stratigraphic column showing geologic formations, a geologic cross-section and descriptive material on the structural and economic geology of each quadrangle.

Maps are priced at $5.95 each, including shipping and handling charges for Fourth Class mail or $8.95 for First Class mail/United Parcel Service. Prepayment is required. To order, write ISGS Information Office, 615 E. Peabody Dr., Champaign, IL 61820 and specify the map desired.

BIORHYTHMS

Gypsy Moth Project Receives Grant

Michael Jeffords, Joe Maddox and Karen O'Hayer of the Natural History Survey (NHS) have received notice that their grant "European microsporidia as biological control agents of the gypsy moth in North America" has been funded by the United States Department of Agriculture competitive grants program. The award is for $150,000 over a 3-year period.

Injured Soybeans Become More Resistant

It may seem paradoxical, but some leaf injury to soybeans early in the season may render plants more resistant to insect pests later on. Research at the Section of Economic Entomology, NHS, shows that feeding by caterpillars on soybean foliage induces a chemical response in the plants that makes them less susceptible to subsequent attacks.

Researchers are focusing on the chemical nature of this response that may involve well known soybean phytoalexins - compounds produced by the plant following pathogen infection or certain types of mechanical injury. These phytoalexins may represent a sort of plant "immune" response to pests and may have significance in future directions of breeding programs for soybean varieties.

Henebry and Ross Take Prize In Spain

Mike Henebry and Phil Ross of the Natural History Survey attended toxicology symposia in Spain and France and visited several laboratories in these countries. Henebry presented a paper entitled "Use of protozoan community tests for estimating ecotoxicological hazard" and Ross presented a paper on "A comparative study of four microbiological tests for evaluating sediment toxicity" at the Toxicity Testing Using Microbial Systems Third International Symposium held in Valencia, Spain from May 11 to 15.

At the same symposium Henebry and Ross coauthored a poster "Assessment of the ecotoxicological hazard of contaminated sediments using protozoan communities" which won the prize for best poster. Lloyd LeMere did the artwork for the poster. The prize, a unique statue of a loon carved by a Canadian Inuit Indian, will be placed in the NHS display case.

Eleventh Bird Book Published

The eleventh in a series of publications on the birds of Illinois by Jean Graber, Richard Graber and Ethelyn Kirk has been published recently by the Natural History Survey. Its title is **Illinois Birds: Corvidae,** and it is Biolocial Notes No. 126.

Copies of this recent publication may be obtained by writing to Chief Lorin I. Nevling, 172 Natural Resources Building, 607 East Peabody Drive, Champaign, Illinois, 61820.

The Illinois Natural Resources Information System

The Natural History, Geology and Water Surveys are pooling their wealth of automated information on various natural resources and environmental data sets, bibliographies, zoological collections, simulation models, reports and other information to form INRIS, the Illinois Natural Resources Information System.

INRIS is a computerized information system which will allow many persons to have the benefit of cooperative access to a large part of the natural resources data of Illinois. INRIS is designed to enable selected users within educational institutions, local, state and federal agencies, businesses and the public to access this information. In addition to making information available to the public, INRIS should help foster a public understanding of the type of work performed by the Surveys.

Although several of the ideas upon which INRIS is based have been contributed by a number of persons, the current version of the system was developed primarily by Annette Holloway and managed by Ed Armbrust. Those who would like to use or to contribute data to INRIS are encouraged to contact Mark McReynolds, INRIS Director, at (217) 333-6006, or by mail at 172 Natural Resources Building, 607 East Peabody Drive, Champaign, IL 61820.

World Bibliography of Soybean Insects

A monumental bibliography of the world literature of insects associated with soybeans is being readied for publication by SIRIC (Soybean Insect Research Information Center) of the Section of Economic Entomology, NHS, and the College of Agriculture, UIUC. SIRIC is a computerized database for soybean entomological literature.

The bibliography represents over 15 years of effort to compile and analyze this literature and will contain over 5,000 references. It will be published later this year in two volumes. The project is sponsored by the American Soybean Association, The UIUC Agricultural Experiment Station and the NHS.

Illinois Lepidoptera

A 50-person moth and butterfly survey team consisting of institutional-based lepidopterists and a cross-section of Illinois' private citizenry has been assembled by George L. Godfrey of the Illinois Natural History Survey and Everett D. Cashatt from the Illinois State Museum. The team will develop a state-wide data base on Illinois' estimated 2,000+ species of moths, butterflies and skippers. Plans ultimately call for an Illinois Lepidoptera Atlas which will address each species' known distribution, seasonal occurrence (adult and caterpillar), host(s) (caterpillar), and in certain cases, basic habitat requirements (adult and caterpillar).

Natural Resources Book Ready for Distribution

The Natural History Survey recently published **The Natural Resources of Illinois: Introduction and Guide**, beautifully designed and illustrated with more than 200 colorful maps, tables and graphs. Familiar scenes of the Illinois landscape introduce each of the six sections of the 224-page book: General Characteristics, Agriculture, Fish and Wildlife, Climate, Water Resources, Geological Resources.

The Natural Resources of Illinois is available from the Illinois Natural History Survey, Room 172, 607 East Peabody Drive, Champaign, IL 61820 The cost is $10 per copy, and checks or money orders should be made payable to the Illinois Natural History Survey Out-of-state buyers must add the sales tax of their respective states

CURRENTS

Added Salt Protects Fish

Although most fish die or fail to reproduce in acidic waters, a pond in Connecticut and clearwater lakes in Florida and Scandinavia - all highly acidic - do support fish populations.

The high acidity and aluminum contents of these waters, combined with very low concentrations of humic substances (which color water) and calcium - factors recognized as offsetting the toxic effects of acid and aluminum - should make these waters biological deserts.

The waters, however, have a common trait that enables fish to resist physiological stress related to acidity - elevated levels of sodium chloride (common salt).

According to Edward Krug of the Water Survey's Atmospheric Chemistry Section, there is a significant correlation between sodium chloride and fish status. Sodium chloride in water apparently reduces acid stress by mitigating the leaching of sodium chloride out of fish and other organisms. The leaching process is the principal toxic effect of acidic water.

Less Lead into Lakes

It may be that less lead, and perhaps less of other unwanted constituents, is being deposited in the Great Lakes than was the case several years ago. This encouraging news comes from an analysis of atmospheric deposition data collected from a network of sites in the Great Lakes region during 1982 and 1983.

Water Survey atmospheric scientists Van Bowersox, Don Gatz and Jack Su analyzed two years of wet deposition data collected from the GLAD (Great Lakes Atmospheric Deposition) network. This network was funded and operated by the U.S. Environmental Protection Agency's Great Lakes National Program Office and was designed to measure the amount of chemical deposition to the Great Lakes from the atmosphere. The EPA also funded the data analysis performed by the Water Survey.

U.S. EPA had two primary interests in the data analysis: assessing the quality of the data collected from this network and computing the loadings to the lakes, especially of metals like lead and cadmium.

According to Gatz, there is much less lead being deposited into the lakes than there was several years ago, perhaps up to 60% less.

Irrigating Illinois

In 1950, irrigation in Illinois was limited almost entirely to flower fields in Kankakee County. Although irrigation has grown dramatically since then, only about one percent of the state's cropland is irrigated today. With sufficient rain and humidity, most growers in Illinois simply do not need water that irrigation must provide in arid states.

Still, attempts to offset the effects of drought and to increase productivity on sandy soils in some parts of Illinois have led to the spread of irrigation to an estimated 200,000 acres in several counties. As part of a 3-year groundwater management needs study, Water Survey researchers Jean Bowman and Mark Collins have completed a project to evaluate the effects of increased irrigation and drought on groundwater resources in Illinois.

Bowman and Collins concluded that the use of irrigation in Illinois does not appear to have a lasting effect on groundwater resources despite a substantial growing-season demand for irrigation.

The effects of irrigation pumpage are localized and depend heavily on weather conditions. An extended drought or increased irrigation could more seriously impact groundwater supplies, but even this would probably be a seasonal and localized problem.

MOPP Will Clean Up

A Mobile Oxidation Pilot Plant (MOPP) being developed and assembled by scientists in the Water Survey's Aquatic Chemistry Section will take water treatment processes out of the laboratory and into the field.

The treatment processes convert organic water contaminants to harmless products such as carbon dioxide, water and oxygen. Although the laboratory studies indicate the possibility of using such processes for cleanup of contaminated groundwater and treatment of industrial wastewater, engineers are reluctant to adopt these environmentally clean processes because of a lack of field-scale data, design criteria and reliable cost estimates.

The MOPP can be moved around and adapted for use at selected industries with hazardous wastewater and at groundwater contamination sites. It will consist of a large moving van trailer which will house equipment for carrying out a process known as Photolytic Ozonation/Peroxidation. During this process ozone is bubbled into water while ultraviolet light is shined through it. The ultraviolet light causes a photochemical reaction of ozone which leads to production of hydroxyl radicals. These radicals are capable of destroying virtually any organic compound.

Testing of the assembled MOPP unit should begin this December. Actual field use may begin by the summer of 1988.

Old Tires for New Habitats

Over 2000 old tires are expected to put the brakes on damaging wave action in a portion of Peoria Lake on the Illinois River, resulting in an improved habitat for gamefish and waterfowl in this troubled area.

The tires were assembled into a 25-ton artifical reef 710 feet long by five feet wide and about 2½ feet high. The reef was then towed out to the shallow waters of a bay in Peoria Lake during the last week of May.

The rubbery reef rests on the lake's muddy bottom and will replace a natural structure - fallen trees and rocks - which is now buried under a deep layer of sediment. The breakwater will reduce the force of waves in the shallow water by absorbing the wave energy. This will reduce the resuspension of bottom sediments and allow them to settle out of the water.

Scientists in the Water Survey's Water Quality Section hope that before long it will serve as a home to increased bass, bluegill and channel catfish populations by providing in-lake structure and by reducing the amount of suspended sediment in the water.

CENTERING ON WASTE

Major Waste Reduction Conference

The Hazardous Waste Research and Information Center (HWRIC) is cosponsoring a major conference on hazardous waste reduction to be held on Sept. 22 and 23 in Chicago. The conference will focus on what Illinois industries and government are doing to reduce the amount and toxicity of hazardous wastes produced at the source and also present an overview of waste reduction efforts nationally.

Presentation of Illinois' annual "Governor's Innovative Waste Reduction Awards" will be made at the conference. These awards were created to recognize and further encourage the efforts Illinois industries are making to minimize the volume and toxicity of hazardous wastes they generate.

Most of Rockford Aquifer Remains Clean

Although some of the wells in or around Rockford, Illinois, may be contaminated, there is evidence that most of the aquifer is not polluted.

These are the findings of a recent HWRIC-sponsored study by H. Allen Wehrmann and Thomas R. Holm of the Illinois State Water Survey and Richard C. Berg of the Illinois State Geological Survey.

The research team used existing data on the geology and hydrology of the area and sampled 69 private domestic and industrial wells. The samples were checked for contamination by volatile organic compounds. Public water supply wells were not sampled because extensive sampling of these wells had already been done by state and local agencies.

According to Wehrmann, nine contaminated areas were found, but they appeared to be related to other known instances of pollution. However, the researchers did conclude that more investigation was needed in the southeast Rockford area. It is there that a 2-mile portion of the aquifer has been contaminated. The extent of contamination and its source must be.determined before cleanup is possible.

Household Hazardous Waste

HWRIC is sponsoring a survey research project to assess the public's level of knowledge about household hazardous waste. The survey will be conducted in Champaign-Urbana in conjunction with a household hazardous waste collection drive to be held September 13, 1987. The collection drive, which is being sponsored by the Champaign-Urbana Intergovernmental Solid Waste Disposal Association, will be the first one of its kind in Illinois. Hazardous wastes from farms will also be collected in the day-long event.

Researchers will survey a random sample of Champaign-Urbana residents once in July before the public education and publicity for the collection program begins. Researchers hope to assess residents' awareness of which household products may threaten human health and the environment if not disposed of properly. Residents will also be asked how they usually dispose of such products. Other surveys will be conducted during and after the collection drive to assess the effectiveness of the education and publicity. The results of this survey will be used to guide education and publicity efforts for other collection drives.

HWRIC was appropriated $500,000 from the state's Solid Waste Management Fund for financial assistance to local governments for household waste collection and disposal. If this money is released, HWRIC will solicit proposals from local governments and help coordinate additional household hazardous waste collection drives.

Air Toxics Montitoring

Interim results of an ongoing HWRIC funded research project indicate that the levels of toxic trace elements in the air in southeast Chicago and East St. Louis generally are not any higher than most other major U.S. urban areas. The three exceptions are slightly higher concentrations of cadmium in East St. Louis and higher levels of manganese and chromium in southeast Chicago.

However, according to principal investigator Clyde Sweet of the Illinois State Water Survey, the fact that the concentraion levels are similar to other cities does not mean they are not harmful. Because health standards for most of these elements have not been set by the federal government, it is not known whether the concentration levels found in this study are potentially harmful. Lead is the only toxic trace element for which ambient air quality standards have been set.

The Shrew . . .

"It is a ravaging beast, feigning itself gentle and tame, but, being touched, it biteth deep, and poysoneth deadly."

The smallest of all living mammals - the shrew - was also the most feared in Europe during the 16th and 17th centuries. Reverend Topsell's observation, above, made in 1658 in his book, "History of the Four-footed Beasts and Serpents," was common knowledge to all, including William Shakespeare whose most famous shrew, Kate, was finally tamed. How the shrew came by such a bad reputation in England and the Continent is a mystery, since the shrew that does dispense poison is not found in Europe but in America.

. . . is small . . .

Shrews and moles, of the Order INSECTIVORA, are the most primitive of the known living placental mammals, and all Illinois mammals except the opossum are placental. Shrews, roughly the size of mice, occur worldwide except for Australia, Greenland and most of South America. There are five genera of the shrew family in Illinois: the masked shrew, the southeastern shrew, the pigmy shrew, the short-tailed shrew and the least shrew. All are burrowing, thick-furred animals.

Shrews come in two sizes, small and smaller. The masked shrew *(Sorex cinereus)* is frequently mistaken for a mouse. Its body length is 3 to 4-1/4 inches and it weighs about 1/8 to 1/4 ounce. Unlike the mouse, it has fine velvety fur, a sharp conical muzzle, and pincer-like teeth that are tipped with red. Its upper parts are brown, its under parts smoky gray. "Masked shrew" comes from its eyes and ears which are masked or covered with short hair. In Illinois the masked shrew is uncommon and is found only in the northern fourth of the state.

The southeastern shrew *(Sorex longirostris)* is about the same size and proportions of the masked shrew except for its skull characteristics and its fur, which is reddish-brown. It is also close in size and appearance to the pigmy shrew, and differs from this genus only in dentition pattern. The southeastern shrew is one of the least-seen mammals in Illinois, found only in Alexander, Coles, Fayette and Johnson counties.

The smallest of all American mammals is the pigmy shrew *(Microsorex hoyi)*, now very rare in Illinois with the last known specimen taken in the middle of winter in a garage in Cook County. The adult pigmy shrew weighs in at less than 1/8 of an ounce; it would take 8 of these shrews to make up the weight of a white-footed mouse, 400 to equal the weight of a fox squirrel, and several thousand to equal the weight of a bobcat. The pigmy shrew is a uniform light brown on the upper parts and slightly paler brown on the lower parts. Its appearance is very similar to that of of the masked and southeastern shrews, differing only in size - smaller - and dental formula.

Easily mistaken for a mouse or young mole, the short-tailed shrew *(Blarina brevicauda)* has some features of both and is sometimes referred to as the mole shrew. This shrew is about the size of a mouse, weighing 1/2 to 1 ounce with an overall body size of 3-3/4 to 5 inches. It can be distinguished from the mouse by its plush, black velvety fur, sharp-pointed nose, short tail and seeming absence of ears which are hidden in the fur. Unlike the mole, this shrew has eyes that are functional and front teeth that are not broad and spade-like. The short-tailed shrew is common throughout Illinois.

Picture a miniature short-tailed shrew and you have the general appearance of the least shrew or old-fiend shrew *(Cryptotis parva)*. It can be distinguished from the masked and southeastern shrew by its shorter tail, and from the short-tailed shrew by its grayish brown, not black, color. Its overall length is 2-1/2 to 3-1/8 inches, and generally weighs 1/10 to 2/10 of an ounce. The least shrew occurs throughout Illinois, but seems to be relatively scarce in the northern part of the state. Except for *Blarina brevicauda*, the least shrew is the commonest shrew in Illinois.

. . . is hungry all of the time . . .

And no wonder, with a metabolic rate unparalleled among mammals: a high basal matabolism of 130 compared to 78 for man and a high rate of respiration which is 140 times a minute while at rest compared to 15 for a man. Shrews do not hibernate and are active throughout the year even in the coldest part of their range. Their activities cannot be called either nocturnal or diurnal, since they are active throughout the 24-hour day. In order to meet their energy needs, they must feed day and night. In a single day, a shrew can eat one, two, or even three times its body weight.

The masked shrew, which is usually found under a dense growth of weeds or in woods, feeds on mice, insects, snails, worms, dead animals and occasionally nuts and berries. Like other Illinois shrews, it possesses scent glands that secrete a musky fluid which at times renders the animal undesirable to predators. Its eyesight is poor, but its sense of smell is good. The masked shrew has a sixteen-month life spent mostly in pursuit of food, with time out to raise 3 litters of 4 to 10 young each. Sleep is taken in very short snatchs.

Little is known about the feeding habits of the southeastern shrew or the pigmy shrew, except that the pigmy shrew inhabits dry woodlands, thickets, and grassy clearings where it feeds primarily on insects.

Much more is known about the short-tailed shrew. It is primarily an animal of forest floors, forest edges, meadows near woods, or swampy, brushy habitats. *Blarina* varies its diet of insects and earthworms with mice, snakes, birds, and other shrews, usually catching them when they enter its underground tunnels. Roots, nuts, fruits and berries comprise the vegetable foods taken most often in winter. On the average this shrew eats half its body weight in food every 24-hours. The short-tailed shrew has very poor eyesight and its sense of smell is not well-developed. However hearing is acute, as is the sense of touch.

Blarina has the same scent glands as other shrews, but also possesses that something special that legends are made of: salivary glands which secrete a poison that can kill or render helpless the shrew's prey.

Like other shrews, the least shrew has an insatiable appetite. Drs. Carl Mohr and Donald Hoffmeister described a least shrew in captivity feeding upon seven grasshoppers in 30 hours. The shrew killed each one by biting the head, then eating the insect head first, then discarding wings and hind legs as it came to them. In the wild this shrew feeds on small insects, snails, slugs, earthworms and the dead bodies of small mammals. The least shrew does not incline to vegetarianism, but without the poison glands of *Blarina,* fears and avoids mice.

. . . and is very belligerent.

The most dangerous of the shrews is the short-tailed shrew. This shrew and the male duckbilled platypus are the only known kind of mammals that have venom. In the shrew it is used to disable and kill its prey.

Pearson (1942) describes the process: "The shrew venom is produced in the submaxillary glands and is led by a pair of ducts to an opening near the base of the lower incisor teeth. The median pair of lower incisors projects far forward, forming a groove along which the venom can flow into a wound. This injection system is less efficient than hollow fangs and is almost ineffective against humans. No human fatalities resulting from shrew bites are known, and only a few local reactions have been reported."

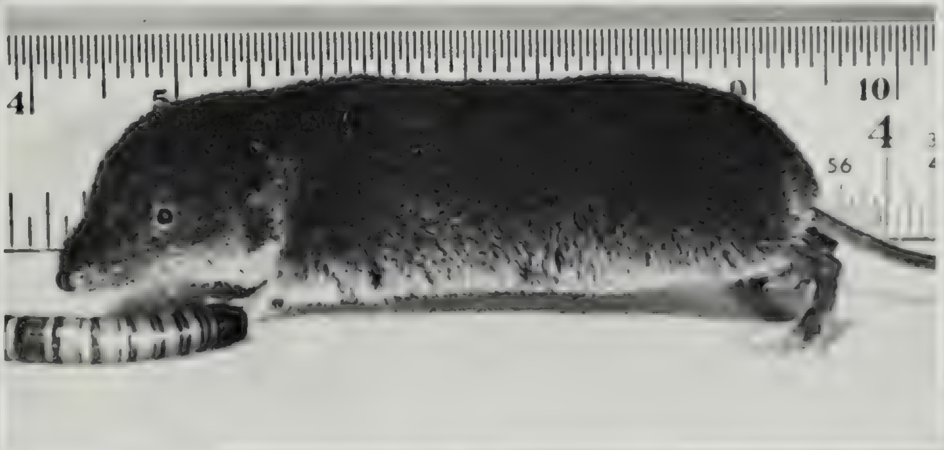
That is not the case for smaller mammals, in which the injected poison slows the heart and breathing of the victims and may cause disintegration of the muscle. The submaxillary glands of one adult short-tailed shrew contain enough poison to kill 200 mice.

Since the short-tailed shrew is not indigenous to England or the Continent, and no one has suggested that it migrated there, the fear of shrews is hard to explain. One possibility is that the European water shrew is poisonous, since it has submaxillary glands similar to those of the short-tailed shrew. The citizenry may have believed that if one shrew is poisonous, they all are. Even without the poison glands shrews in general are highly aggressive in their habitats, which may account for their fearsome reputation.

In any event shrews are not recommended as house pets, which, come to think about it, may have been Shakespeare's point.

Ernest P. Walker, Washington, D.C.

The Masked Shrew



Ernest P. Walker, Washington, D.C

The Least Shrew

Maslowski and Goodpaster, Cincinnati, Ohio

The Southeastern Shrew

TRANSITIONS

Harvey Sheldon

Albert Pyott

Society Elects New Board Members

Harvey M. Sheldon has been elected to the Board of the Society for the Scientific Surveys. Mr. Sheldon is a partner in the law firm of Coffield Ungaretti Harris & Slavin in Chicago. His practice includes prosecution and defense of environmental cases, including workplace and environmental chemical exposure cases and federal, state and local regulatory compliance with air, solid and hazardous waste, wastewater discharge and other laws.

Mr. Sheldon chairs the Environmental Regulation Committee and is a Director of the Chicago Association of Commerce and Industry. He is a member of the Environmental Regulation Committee of the Illinois State Chamber of Commerce, and teaches environmental law at Loyola University Law School in Chicago. He graduated from Amherst College in 1965 and received his law degree from Harvard Law School in 1968. Mr. Sheldon resides in Wilmette.

Albert E. Pyott has also been elected to the Board of the Society for the Scientific Surveys. He recently started the American Dynabrite Corporation in Lake Forest, which develops a product to address the need for improved traction in agricultural vehicles and related markets. Prior to this, Mr. Pyott enjoyed a thirty-year career combining senior management responsibilities in sales and marketing at Inland Steel Industries with volunteer leadership roles in the fields of conservation and natural resource restoration.

Since 1983 Mr. Pyott has been a board member and Vice President of the Open Lands Project, as well as a board member and Vice President of Wetland Research, Inc., working on funding strategies for both projects. He is a member of the National Wildlife Federation, Ducks Unlimited, the Nature Conservancy and Trout Unlimited.

A resident of Winnetka, Mr. Pyott is a graduate of the Harvard Business School and Cornell University.

Society Moves to New Offices

The Society for the Surveys has moved its offices to 1525 S. 6th Street, Suite B, Springfield, Illinois 62703. The new phone number for the Society is (217) 522-2033.

Society for the Illinois Scientific Surveys

Membership in the Society

Membership is open to any person or group that subscribes to the purpose of the Society. Two kinds of membership are offered — personal and corporate or organizational.

Support for the operation of the Society and its programs is sought from individuals, businesses, corporations, and foundations. The Society has a 501(c) 3 tax status, and contributions are tax-deductible.

The Society for the Illinois Scientific Surveys

Scale of Contributions

Personal Memberships		Corporate/Business Memberships	
Founding	$1,000 per year	Founding	$10,000 per year
Contributing	100 per year	Benefactor	5,000 per year
Family	50 per year	Associate	1,000 per year
Individual	25 per year	Patron	250 per year

Benefits of Membership

The magazine of the Society, **The Nature of Illinois,** is sent without charge to all members, personal and corporate

In addition, **corporate members** receive the following services

Speakers Bureau. Speakers from the three Surveys are available to talk on such topics as hazardous waste, acid rain, ground-water problems, Illinois coal, radiocarbon age dating, sport fish, farmland wildlife, and Illinois prairies

Special Seminars. Seminars tailored to the interests of businesses and industries may be arranged

Field Trips. Field trips for groups from individual industries and organizations may be conducted upon request

Informal Meetings. The Chiefs of the three Surveys meet annually with interested corporate members to discuss topical issues

Free Publications. Survey articles, monographs, maps and pamphlets are available on an ongoing basis. In addition, the Society publishes an annual summary of research underway at the Surveys

(Tear off and return)

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THE NATURE OF ILLINOIS

Winter, 1988

Published by the Society for the Illinois Scientific Surveys

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The wonder of an Illinois winter. Photo credit: Central Illinois Light Company

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Editorial Staff

Jane A. Bolin
Editor

ComUnigraph
Design and Production

Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 1525 South 6th Street, Suite B, Springfield, IL 62703

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The Society Page

After the holiday season, the pace of life seems to slow as if in anticipation of spring and the growing season. However research and development projects know no season, and so the scientists at our three Illinois Scientific Surveys are very busy at this time of the year as at all times.

Those of you who are grappling with winter's miseries will appreciate **The Snow Birds: A History of Illinois' Great Winter Storms,** based on data gathered by the Illinois Water Survey.

Scientists at both the Water and Geological Surveys are working under great pressure to provide technical data for the safe siting of Illinois' radioactive waste disposal facility. Their work is reported in **Finding a Safe Place for Low-Level Radioactive Waste.**

Economic development is high on the research agendas of all three Surveys. The Natural History Survey is working on developing alternative crops for Illinois' farmers, including what has traditionally been a Japanese export, **shiitake mushrooms.**

An adequate supply of quality water is essential to any area's economic well-being. The Geological Survey is cooperating with northern Illinois' communities in locating **shallow groundwater resources.** At the same time, the Water Survey is hard at work rejuvenating public water supplies hampered by **lake eutrophication.**

It may seem early to think about mosquitoes, but what about a breed that likes to live with man and may be wintering in Chicago? **The Asian tiger mosquito,** first found in the continental United States in 1985 on the west coast, is now an Illinois native. Natural History Survey researchers are gathering the data needed to control this formidable health threat.

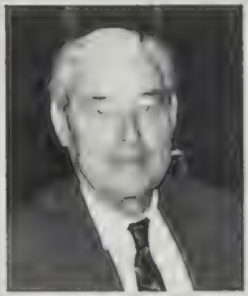
Finally, I hope you enjoy reading about the **bat,** one of nature's most efficient insecticides and one of her most maligned creatures.

I am constantly amazed by the breadth of research projects conducted by our three Surveys. I hope you will join me in supporting this research by becoming a friend of the Surveys through membership in the Society.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors



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The Snow Birds:

Being An Account of Cold Tuesday, the Winter of the Deep Snow and Other Great Illinois Winters

---

> About two o'clock in the afternoon it began to grow dark, from a heavy black cloud which was seen in the northwest. Almost instantly the strong wind, traveling at the rate of 70 miles an hour, accompanied by a deep bellowing sound, with its icy blast, swept over the land, and everything was frozen hard. The water in the little ponds in the roads froze in waves, sharp-edged and pointed, as the gale had blown it. The chickens, pigs and other small animals were frozen in their tracks. Wagon wheels ceased to roll, froze to the ground. Men, going from their barns or fields a short distance from their homes, in slush and water, returned a few minutes later walking on the ice. Those caught out on horseback were frozen to their saddles, and had to be lifted off and carried to the fire to be thawed apart. Two young men were frozen to death near Rushville. One of them was found with his back against a tree, with his horse's bridle over his arm and his horse frozen in front of him. The other was partly in a kneeling position, with a tinder box in one hand and a flint in the other, with both eyes wide open as if intent on trying to strike a light. Many other casualties were reported . . . the ice was frozen in the stream, as variously reported, from six inches to a foot in thickness in a few hours.
>
> John Moses
> *Illinois historical and statistical*
> Fergus Printing Co., 1889

It was known as "The Sudden Change" of December 1836 to Illinois pioneers and to writers like John Moses, whose accounts of one of Illinois' great winter storms have become part of Illinois' weather folklore. To other Illinois settlers it was "Cold Tuesday" or "The Cold Day in Illinois." In Lacon Township it was named "Butler's Snap" in memory of a Mr. Butler and his daughter who were tragically frozen to death.

"The Sudden Change" is probably most descriptive of the snowstorm and coldwave that passed through Illinois on December 20, 1836. Temperatures fell 40 degrees fahrenheit from morning to two p.m. at Augusta, Illinois, accompanied by 70 mile per hour winds, as reported by Dr. Samuel Mead of that city. The Mississippi River was frozen from this date until April 15 at Rock Island, and Lake Pepin (within the Mississippi River halfway between LaCrosse, Wisconsin and St. Paul) was closed with ice until May 20. The cold front was reported to have passed Burlington, Iowa on the Mississippi at ten a.m. and to have been in the vicinity of Springfield by two p.m. — showing forward progress of about 50 miles per hour.

The first account of a severe Illinois *winter* was that of 1830-1831, "The Winter of the Deep Snow." This winter received great attention in local histories and pioneers' diaries. In fact a cult grew up around that winter, with the settlers who survived it in their log shelters gathering together at the annual Old

Settlers' Day meetings to recount again and again their experiences. They became known as the "snow birds."

Heavy snow began to fall on December 29, 1830 in northern Illinois, accumulating in the second week in January to 30 inches at Peoria, 24 inches at Fort Armstrong (Moline), and two and one-half to three feet at Jacksonville. The second snow of that winter increased Peoria's snow cover to a reported four feet. There was floating ice in the Mississippi River at St. Louis in mid-December, and the river was completely frozen by mid-January.

One snow succeeded another, often with sleet storms interspersed, producing a crust of ice upon which the next snowfall piled even higher. Sunless days and icy cold temperatures were the norm. An eclipse of the sun added to the dreariness. People rarely went out. Late in the winter Abraham Lincoln and his father Thomas had to leave their home near Decatur to ask for food from their neighbors. They were not alone in their hardship. In Springfield Pascal Enos and his two teams of oxen saved the lives of many by keeping the way to the mill and wood lot open and by delivering large logs to his less fortunate neighbors. Once-plentiful game became virtually non-existent, and snow was cleared off fields of corn to keep the settlers alive.

Every Illinoisan, whether of the 19th or 20th century variety, has his or her worst winter story. The second worst winter storm since 1900 belongs to Chicagoans. On January 26 and 27, 1967, the forecast in Chicago called for four inches of snow. In 29 hours 23 inches of snow fell, winds of up to 53 miles per hour howled through the city, and Chicago shut down. Twenty-six people died from snow-related activities.

Illinois' 1977-1978 winter was the worst winter the state has experienced since the turn of the century. Along with 18 severe winter storms, northern Illinois maintained at least one inch of snow on the ground for 120 days and southern Illinois for 90 days. The 1978-1979 winter was also memorable, for in addition to its 17 severe winter storms, it was the third consecutive severe winter in Illinois. The winter of 1981-1982 was the fourth severe winter in six years, and the second most severe on record, again with 18 major winter storms.

For Central Illinois communities, Good Friday 1978 brought a special chill. Central Illinois experiences more freezing precipitation events in the mean than either north or south Illinois. Freezing rain or freezing drizzle can be especially destructive since ice forms on surfaces of roads, wires, houses and trees and exerts tremendous weight on those surfaces. The area between Springfield and Champaign was particularly hard hit that Easter weekend as trees toppled, wires were torn loose from poles, and electricity was interrupted for up to three weeks. One television station's tower fell to the ground due to the weight of accumulated ice, and the station was off the air for one and one half years.

The Cold Hard Facts

Severe winter storms in Illinois produce more total damage than any other form of short-term severe weather, including tornadoes, lightning and hail. Illinois experiences five severe winter storms on the average. Any one storm will not impact the entire state. A severe winter storm is defined as at least six or more inches of snow in 48 hours or less somewhere in the state, or damaging ice over at least 5,000 square miles. A storm with less snow or ice may still be classified as a severe winter storm if high winds or extreme cold accompany the storm and it results in deaths or significant damage.

These storms are usually more frequent in northern Illinois but not always. Central Illinois has the distinction of experiencing more freezing precipitation storms than either north or south. Because of central Illinois' flat terrain, strong easterly winds often accompany winter storms, resulting in substantial drifting of snow. The 1977-1978 winter storms caused substantial drifting, closing the University of Illinois at Champaign for the first time ever and trapping some motorists in their cars for periods of hours to several days.

Severe winter storms normally move from southwest to northeast across the state. They are most likely to occur in an area north of a line from Quincy to Chicago. In the early winter, they often include snow, strong winds and blowing snow behind the storm center — the

The first account of a severe Illinois *winter* was that of 1830-1831, "The Winter of the Deep Snow." . . . a cult grew up around that winter, with the settlers who survived it in their log shelters gathering together at the annual Old Settlers' Day meetings to recount again and again their experiences.

Chicago, January 27, 1967: Snowbound cars & buses completely block Cermak Road east of Wabash Avenue. (Chicago Tribune photo) low pressure area. In addition these storms often include strong thunderstorms and even tornadoes ahead of the storm in the warm air sector. The tendency for thunder and tornadoes decreases in late winter, when temperatures are cold enough to inhibit that activity.

Severe winter storms occur most frequently in January, with a 70% chance of one or more such storms during that month. December, February and March rank close behind in numbers of storms. High incidence periods of severe winter storms are December 24, 25 and 26 and March 2 and 3. Low incidence periods are December 3-4 and 15-16, January 3-5 and 23-28, February 20-24, and March 15-17 and 21-24.

The earliest severe winter storm in Illinois occurred on October 28-29, 1925; the latest on May 1-2, 1929. The winters of 1977-1978 and 1981-1982 saw the most storms — 18 each — recorded in Illinois weather history. The fewest storms, a paltry (by Illinois standards) two, occurred in 1921-1922 and 1980-1981.

The average Illinois winter storm duration at any one location is about 14 hours, and the area of impact at any one time is about 50 miles north to south by 155 miles east to west.

Depiction of weather types related to severe winter storms in Illinois.

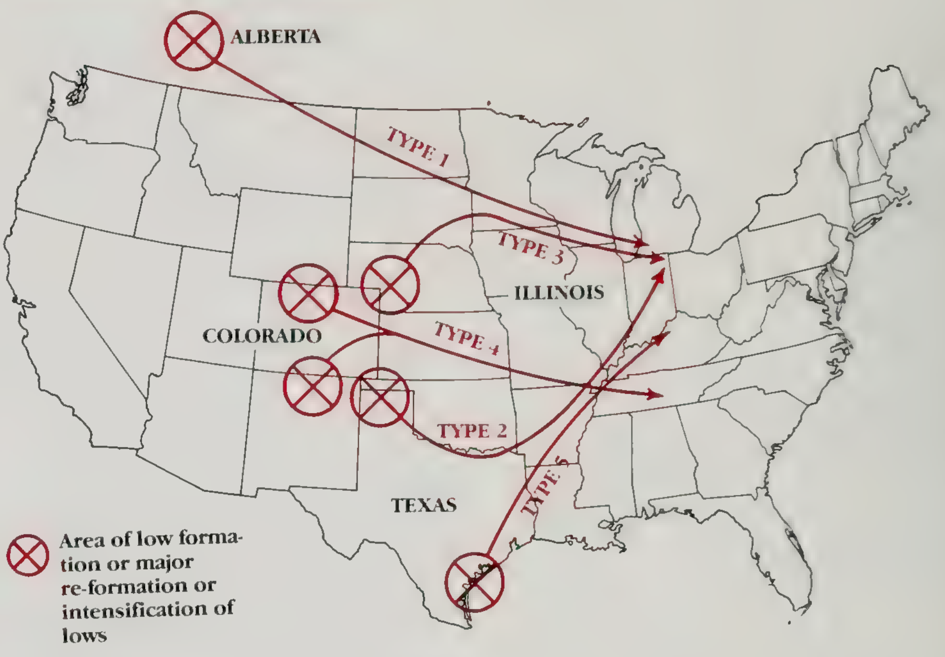

ALBERTA
TYPE 1
TYPE 3
ILLINOIS
COLORADO
TYPE 4
TYPE 2
TEXAS
TYPE 5
Area of low formation or major re-formation or intensification of lows

Figure 1

Rocky Mountain High

Most Illinois winter storms take shape hundreds or even thousands of miles away. Low pressure systems traveling east from as far away as Asia may move into the United States from off the Pacific Ocean. Many of these disturbances die in the mountainous southwest as they cross the rough terrain. Some do make it across the mountains and redevelop just east of the Rockies.

Most Illinois severe winter storms originate in Colorado, according to Illinois Water Survey (IWS) climatologists. Two other areas — the Province of Alberta and the Texas Gulf Coast — also contribute to Illinois' white look during the winter. As shown in Figure 1, there are five severe winter storm types, three of which (2, 4 and 5) affect Illinois based on the source of the storm and the track they follow.

Only a small percentage of storms that develop in these favorable areas become severe winter storms in Illinois. Storms form where there are the greatest contrasts in temperatures. The battle ground for these air masses is the leeward side of the Rockies and the western Gulf coast. Once the storms have developed, the winds in the upper atmosphere determine where and how fast they will move . . . and if Illinois is going to get socked.

Damage from severe winter storms can be very expensive. Transportation shuts down, businesses and schools close, power and communication are disrupted, and auto accidents increase. IWS climatologists estimate that snow costs us $50 million an inch.

Always Prepared

When a winter storm is forecast for your area, the Illinois Water Survey suggests that you keep the following rules in mind:

- Check battery-powered equipment like radios and flashlights before the storm begins.
- Check your fuel supply if you heat with wood, oil or bottled gas.
- Check your food and make trips for supplies before the storm develops. Include food that does not require refrigeration.
- Check your home for hazards from fireplaces, over-heated stoves, space heaters and furnaces.
- Stay indoors unless you are in excellent physical condition. Don't kill yourself shoveling snow!
- Dress properly. Layers of protective clothing are your best bet in keeping warm.
- If you are traveling by car, seek refuge if storm conditions worsen. Plan ahead and select alternate routes. Try not to travel alone. Always have a full tank of gas if venturing into open country. Carry a winter storm kit consisting of: blanket, shovel, bag of sand, flashlight, booster cables, windshield scraper. Also carry a small supply of high-calorie non-perishable food such as nuts or candy bars.

Feeling Blue?

One last word of encouragement. Winters of the last few years in Illinois have been subdued compared with those of the late 1970s. On Christmas of 1982 temperatures in central and southern Illinois were in the 60's. During the winter of 1986-1987 Illinois experienced only two major winter storms. The winter of 1987-1988 could prove one for the record books, but hopefully only for the least number of winter storms ever recorded.

This article is based on the work of Dr. Wayne M. Wendland, State Climatologist and others with the Illinois Water Survey. Dr. Wendland is an Adjunct Professor of Geography at the University of Illinois in Champaign. He has been with the Water Survey for seven years and earned his Ph.D. in Meteorology at the University of Wisconsin-Madison.

The Big Bite

It came from Japan, hitching a ride on a shipment of used tires bound for a reprocessing plant in Houston. It spread to New Orleans, Kansas City, as far south as Jacksonville, Florida, as far north as Greenville, Ohio. It is now in Illinois and it is the biggest development in American medical entomology in the last 25 years.

"It" is the Asian tiger mosquito *(Aedes albopictus),* a potentially lethal species of mosquito whose range extends from the tropics of southeast Asia and the Pacific Islands north through China, Japan and Southern Siberia. The Center for Disease Control in Atlanta reports that, as of August 31, 1987, the Asian tiger mosquito has been found in sixteen states, including Illinois.

Harris County Texas is no stranger to mosquitoes, with more than 54 species indigenous to the area. But on a hot August day in 1985 Taweesak Wuithiranyagool, an inspector with the local mosquito control district, bumped into a tire containing a mosquito trap and was roundly attacked. Harris County knew its 55th species was something special.

The biting adult is an aggressive mosquito. Aquatic larvae were found in used tires, broken television sets, soda cans, chain-saw handles — any kind of container that held water seemed to do. Houston authorities, aided by the Smithsonian Institution, finally determined that the mosquito with the single silver stripe running down its back was a new mosquito with significant disease potential. Mosquito control officers hoped that the outbreak was local, that its spread could be prevented.

Black September

Their hopes were unfounded. New Orleans, once called the Necropolis of the South because of its frequent yellow fever epidemics, was duplicating Houston's experience. On April 4, 1986, *Aedes albopictus* was found in an auto salvage yard in the eastern part of the city. Within weeks, it was all over the city, and mosquito control officers discovered more bad news. The insect was resistant to malathion, the insecticide used most often during epidemic disease outbreaks.

Worried entomologists called it Black September. During the summer months of 1986, the mosquito had spread to all the Gulf Coast states from Texas to Florida; north to Indianapolis, Indiana; Mt. Vernon and East St. Louis, Illinois and Greenville, Ohio; and west to Kansas City, Missouri. Populations of the mosquito were intercepted in Seattle, Washington, in tires originating in Japan. During the summer of 1987 a major infestation of *Aedes albopictus* was found in downtown Chicago, significantly increasing its north central extension. A similar northern movement occurred along the Atlantic Seaboard from North and South Carolina to New Jersey.

The Asian tiger mosquito is rapidly becoming the American tiger mosquito as well. Based upon the work of entomologists William Hawley and Stefan Nawrocki of the University of Notre Dame, any place east of the Rockies and south of a line from Maine to Chicago is fair game for the insect. Recently it has moved into Brazil and Argentina.

Why are entomologists so worried?

A Domestic Mosquito

Aedes albopictus is an extremely aggressive and voracious biter. It feeds on humans, birds and other mammals and may feed on reptiles and amphibians as well. It can breed in any container with a little water in it. It has been found in natural containers, but also in the holes of bowling balls, flowerpots, cemetery vases, tin cans, drums and buckets. It is active during daylight hours. It can live indoors with man. It can complete its aquatic lifecycle from egg to adult in as little as 7 days. It is a fierce competitor and can easily replace less harmful local species. It is a major carrier of disease, one of the few such to invade the United States in the last 300 years.

The last major mosquito health threat in this country came from *Aedes aegypti*, also known as the yellow fever mosquito. Between 1693 and 1901 it killed an estimated 100,000 people in this country and infected half a million. The Asian tiger mosquito is potentially more dangerous than *Aegypti*. It is a known carrier of all four types of epidemic and hemorrhagic dengue. Any soldier who served in World War II in the Pacific is probably familiar with dengue and its joint pain, fever and rashes. Dengue is not usually fatal, but a related disorder, hemorrhagic dengue, can kill children who experience a second bout with dengue. The most recent large-scale outbreak of dengue occurred in Cuba in 1981, affecting 1% of that country's population — a figure considered very high by epidemiologists. 344,000 people were infected and there were 158 deaths.

> ***Aedes albopictus*** **is an extremely aggressive and voracious biter. It feeds on humans, birds and other mammals and may feed on reptiles and amphibians as well. It can breed in any container with a little water in it. It has been found in natural containers, but also in the holes of bowling balls, flowerpots, cemetery vases, tin cans, drums and buckets.**

The Cuban fatality rate was very low, due to that country's ability to hospitalize large number of dengue patients, thus circumventing hemorrhagic and shock manifestations. Over 100,000 dengue patients were hospitalized during the epidemic.

The Asian tiger mosquito has also been associated with 27 arboviruses (insect-borne viruses) known to affect man, including: Japanese encephalitis, West Nile virus, Kunjin virus, all flaviviruses, Ross River virus, Chikungunya virus, Batai virus, and all Bunyaviruses including LaCrosse and San Angelo viruses. The most serious threats to Illinois are significant potentials for increased transmission of St. Louis encephalitis and LaCrosse encephalitis.

Because *Aedes albopictus* feeds on so many species, it is called the universal vector by entomologists. It can transmit just about anything. For example, because *Aedes albopictus* transmits the LaCrosse virus, it could become the most important carrier of this disease in Illinois and the Midwest. This, coupled with its aggressive behavior and ability to live with man in his home, could significantly increase the number of LaCrosse encephalitis cases in Illinois. Encephalitis is particularly dangerous for children. The mosquito is also a very effective vector of dog heartworm, a parasitic and often fatal disease of dogs, now epidemic in Illinois.

Appearing Now . . . In Illinois!

In the greater Chicago area, approximately nine million tires have accumulated this year — one used tire for every person in the area. And over the past ten years, the Chicago metropolitan area has accumulated close to 90 million tires. No one knows where they are or whether *Aedes albopictus* has made a home in a few, some or most of them.

Chicago authorities do know that *Aedes albopictus* has found Chicago. On August 10, 1987 the Asian tiger mosquito was first collected in a tire yard along the Chicago River between the Webster Street and Cortland Street bridges. A positive identification of *Aedes albopictus* was made at the Smithsonian by Dr. Ronald Ward on August 17. On August 19 and 20, at the request of Chicago's Health Department, a team of nine professionals from the Illinois Natural History Survey (NHS) visited the site.

Through bite counts (one scientist counts the number of mosquitoes landing on and biting the arm of another scientist) NHS staff were able to determine that the yard was heavily infested and that eradication was not feasible. The number of mosquitoes biting was 22 to 25 per minute.

NHS staff did find the answer to control of the mosquito. Corncob granules, impregnated with *Bacillus thuringiensis*, were filtered through the tire piles to kill off the larvae of *Aedes albopictus*. The results were impressive: 89%, 98% and 85% control (dead larvae) of the tires sampled. No further application was required.

NHS staff were also concerned about the extent of infestation outside of the Webster Street Tire Yard, and with good reason. *Aedes albopictus* was found one mile away from the yard. Additionally, large numbers of potential habitats for the mosquito were found as far away as three miles, in both residential and commercial areas. The NHS scientists established a house/factory index of 47%: 47% of 136 premises surveyed by the scientists had at least one potential larval habitat.

Dr. Robert Novak, a medical entomologist with the Natural History Survey, enumerates the dangers for Illinois and the research that has yet to be done: "We need to know if this species can overwinter in Chicago, that is, survive the winter and still impact on man. Our guess is that it can, and that it has already spread throughout Illinois. We need to map all of the tire yards in Illinois to back that guess up. And we need to know if *Aedes albopictus* is replacing Illinois' natural mosquito species. Again, our guess is yes or very soon. We also need to research insecticide resistance and, very importantly, whether the mosquito has actually begun transmitting any diseases. What we need to know is staggering."

"We've had funding, but that money runs out soon. We'll be looking for more. The problem with this kind of situation is that people want the body count — how many people are sick, how many are dying. We don't want to wait until the bodies stack up. I've heard a fellow entomologist describe *Aedes albopictus* as a black box — in health terms is it a tiny firecracker or a big stick of dynamite? No one knows for sure. But can we afford to wait?"

"We're not isolated by the oceans anymore in this country. We're seeing rapid worldwide movement of goods and people, and that means the potential for a whole host of exotic insects, plants and associated diseases that this country has never seen before. Illinois is the hub of a huge transportation network. Goods are moving up our rivers to Chicago directly from Asia and South America. Our international air transport through O'Hare Airport is staggering. We have to start thinking in terms of *avoiding* catastrophic behavior."

Dr. Robert Novak is an Associate Medical Entomologist with the Faunistics Section of the Illinois Natural History Survey. He has been with the Survey for the past one and one-half years. Prior to that time he worked for the Center for Disease Control for eight years, three in Atlanta, Georgia and five in San Juan, Puerto Rico. He received his Ph.D. in Entomology at the University of Illinois. Working with the Faunistics Section on this project is the Economic Entomology Section of the Natural History Survey.

Natural History Survey

Aedes Albopictus, *the Asian Tiger Mosquito.*

Sampling a tire pile

Finding A Safe Place For Low-Level Radioactive Waste

Until 1980 the history of low-level radioactive waste (LLW) disposal policy was one of few successes, many failures, detours, dead-ends and confusion and frustration for the public and regulatory agencies alike. In the 1940s and 1950s low-level radioactive wastes were disposed of only at government-owned sites, usually in shallow trenches or packaged in steel drums and dumped into the ocean. Ocean disposal of these wastes ceased in 1970. From 1962 to 1971 the private sector stepped in where even the government was treading trepidatiously. Six commercially-owned sites were established. Three are no longer operating: Sheffield, Illinois; Maxey Flats, Kentucky; and West Valley, New York.

At Sheffield, about 50 miles north of Peoria, the site owner, U.S. Ecology, petitioned the Nuclear Regulatory Agency to expand past the 21 trenches already filled with LLW. The petition met state opposition and was denied in April of 1978: the site was effectively closed.

In the meantime monitoring wells around the site detected tritium (water with a radioactive hydrogen atom) migrating from the site along an underground pathway of 1,200 to 1,500 feet. Tritium, which has a relatively short half-life of 12.3 years, is not as "hot" as other substances disposed at the site. But the fact that there was a pathway — and other more highly radioactive substances could come down that pathway — had state scientists very concerned. In 1982 the site was found to be discharging into standing water in a nearby strip-mined area. A settlement to a state-filed lawsuit against the site owner is still in the process of negotiation.

Kentucky officials were having their own problems with their LLW site at Maxey Flats, which had operated from 1963 to 1977. The site's 48 trenches, filled with more than 4.8 million cubic feet of radioactive wastes, were carved out of shale filled with sandstone lenses. Sand is notorious for its high permeability, and officials discovered that some of the 140 pounds of plutonium scattered throughout the site had moved hundreds of feet from where they had been buried. Tritium migration was found off-site, and in 1977 the site was closed. The state eventually purchased the site and took over responsibility for clean-up, which may cost as much as $131 million.

The three remaining sites still operating — Barnwell, South Carolina; Beatty, Nevada; and Hanford, Washington — put everyone on notice in the late 1970s that they were going to restrict other states' access to their facilities.

It was time for a new approach.

Illinois was the first state to ban shallow land burial of hazardous chemicals and radioactive wastes. Illinois also requires an engineered disposal method such as use of a concrete barrier to separate packaged LLW from the earth.

Congress Steps In

The federal government was grappling with two hot issues: disposal of high-level nuclear waste (HLW) and disposal of everything else that is radioactive. An attempt to develop regional centers for disposal of high-level wastes met with stubborn opposition from the states. In an odd kind of *quid pro quo,* Congress put the burden for developing one (eventually two) high-level waste repository on the federal government and then mandated that the states were responsible for developing their own regional low-level sites.

The law that drives national policy on LLW is the Low-Level Radioactive Waste Policy Act of 1980. It requires each state to assure adequate disposal capability for low-level radioactive wastes generated within its borders, and it encourages that this be accomplished through regional groupings of states, through inter-state waste compacts. These compacts are formed by the states themselves, although Congress must approve the compact. Within each state compact, a host state is selected to develop and oversee a LLW site.

The original operating deadline for these sites was set for January 1, 1986 and was later extended to January 1, 1993. Penalties were attached to non-compliers. By January 1988, compacts, host states and siting plans must be in place or states must be prepared to pay twice the $20 base surcharge for each cubic foot of LLW disposed at the three remaining landfills. By June of 1988 this amount increases to $60 per cubic foot. The three LLW sites still operating will be allowed to restrict other states' access to their facilities after 1993.

Regional groupings have emerged, with compacts formed or forming in the Northwest, Rocky Mountains, Midwest, Central Midwest, and Southeast. Texas will have its own facility, and California will probably join with Arizona. The Northeast will probably form a compact centering around Pennsylvania.

Not surprisingly, Illinois and Kentucky found that, at least in terms of low-level waste, they had much in common. The two states formed the Central Midwest Compact, agreed that Illinois (by far the larger generator of LLW) would host the site, and began work on the siting plan. The Central Midwest Compact has been approved by Congress and has three Commissioners: Clark Bullard, Director of the University of Illinois' Office of Energy Research and Chairman of the Compact; Terry Lash, Director of the Illinois Department of Nuclear Safety; and Donald R. Hughes, representing Kentucky. The Governor of Illinois will appoint a fourth non-voting member from the county in which the site is located.

The Illinois Department of Nuclear Safety (DNS) has been designated as the lead agency in developing the site.

Low Level Waste: What It Is and What It Isn't

The official definition for low-level radioactive waste — everything that isn't high-level waste — isn't very helpful. By exclusion, low-level waste is *not* spent nuclear reactor fuel rods, *not* uranium or mill tailings, *not* byproducts of either nuclear weapons production or spent fuel reprocessing and *not* high-level waste from nuclear reactors or nuclear weapons prodution.

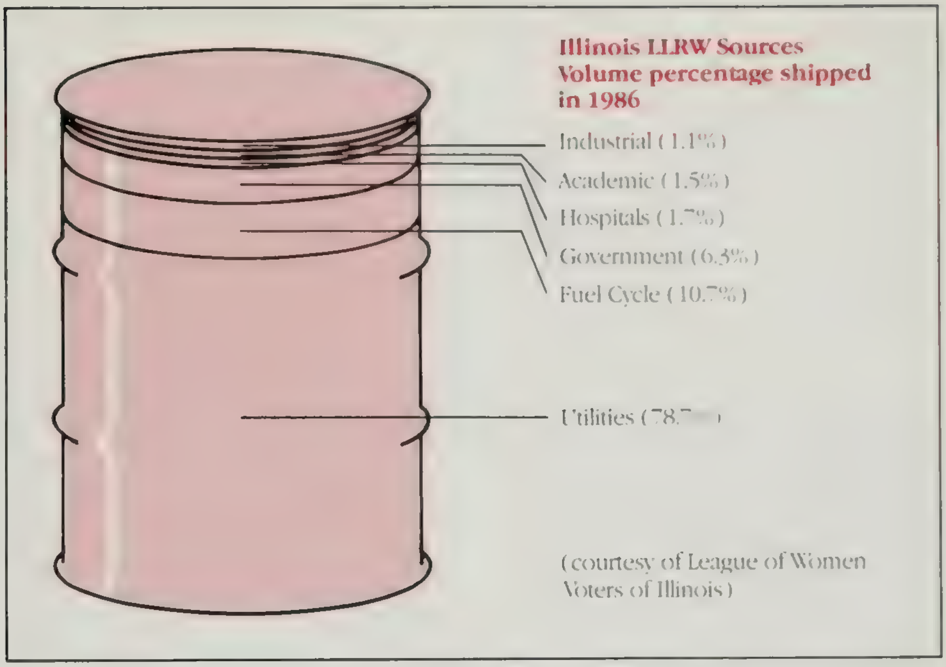
The best way to define low-level waste is by example: Low-level waste includes slightly radioactive clothing worn by utility workers, test tubes and syringes from hospitals and industrial producers, reactor water sludge, and the more highly radioactive irradiated components and steel parts removed periodically from nuclear reactors.

There are about two million cubic feet of LLW produced nationally. Illinois contributes more LLW to this stream than any other state: 218,000 cubic feet in 1986, 77.8% by volume and 99% by activity from nuclear power plant operations. Other LLW waste generators include private companies involved in the fuel cycle, industrial users like pharmaceutical firms, academic researchers, hospital and medical research facilities and state government agencies (see Figure 1 for breakdown by volume shipped).

There are three categories of LLW. Class A and B wastes decay to very low radioactive levels within 100 years. Class C waste, which takes 500 years to decay, must be disposed of in structurally stable waste forms with at least 16 feet earth cover or behind an intruder barrier that will last for the full 500 years. Class C waste includes the irradiated components from nuclear power plants. Environmentalists are most concerned about the long-lived radionuclides in these components, niobium-94 and nickel-59, which occur in extremely small amounts but have half-lives of 20,000 and 80,000 years respectively. Spokesmen for DNS point out that the irradiated components are extremely immobile and will have to be shielded in containers inside an engineered structure at the LLW facility.

Designing for 500 Years

The LLW site, as now envisioned by IDNS, will require 1,000 acres of land, with the disposal facility itself on 100 to 200 acres. State law prohibits siting of a disposal facility closer than one and one-half miles from a non-consenting municipality. A town may agree to a closer site. Costing $10 to 15 million, the site will take in 250,000 cubic feet of waste per year and will have an operating life of 50 to 100 years. It is expected to generate in excess of $1 million per year in tax revenues and other cash payments for the county where it is located and will employ 80 to 100 workers.



(courtesy of League of Women Voters of Illinois)

Figure 1

Illinois was the first state to ban shallow land burial of hazardous chemical and radioactive wastes. Illinois also requires an engineered disposal method such as use of a concrete barrier to separate packaged LLW from the earth. These legislative mandates have important ramifications for the disposal facility's design.

The ultimate design of the facility will depend largely on the contractor selected by DNS to develop the facility, in accordance with the rules promulgated by the agency. Local input into the design will be part of the process. Each design has its benefits and drawbacks. Some options include:

- **Above-ground vault disposal** would be engineered above the natural grade. Roof, walls, and floor would be made of steel-reinforced concrete. Wastes could be inserted through the roof and could therefore be more easily retrieved if necessary. Drawbacks include exposure to the natural elements and no additional barrier if the vault is damaged (see Figure 2).
- **Below-ground concrete vaults** would be engineered with the same steel-reinforced concrete floors, walls and roof used in the above-ground vault. In addition, a layer of earth would overlie the vault. It is less vulnerable to surface elements, but retrievability is a problem (see Figure 3).
- **Earth-mounded concrete bunker** such as that used in France utilizes a base concrete bunker cell. Waste containers are placed in layers with concrete filling in the voids. A concrete roof will be added once the cell is filled. Wastes would also be stored aboveground by stacking canisters and steel drums on top of the cell and then covering the canisters with earth. Class B and C wastes would be stored in the cell; Class A above (see Figure 4).
- **Modular concrete canister disposal** uses individual waste containers placed inside reinforced concrete modular canisters that are then buried in trenches. Grout would be used between the individual containers. This method is closest to shallow land burial but allows for easier accessibility to individual containers (see Figure 5).

Design choice and site geology top the list of concerns of environmentalists like Joanna Hoelscher of Citizens For A Better Environment: "We want to encourage above-ground and highly-engineered structures. We don't want to see shallow land or enhanced shallow land burial."

The Science of Siting: Weighing All the Factors

The site selection process is long and complicated, with many players. In 1985 DNS contracted with the Illinois Geological Survey (IGS) and the Illinois Water Survey (IWS) to provide geologic and hydrologic data to be used in the initial phases of the siting process.

"Along with the Water Survey, our job was to provide DNS with guideli

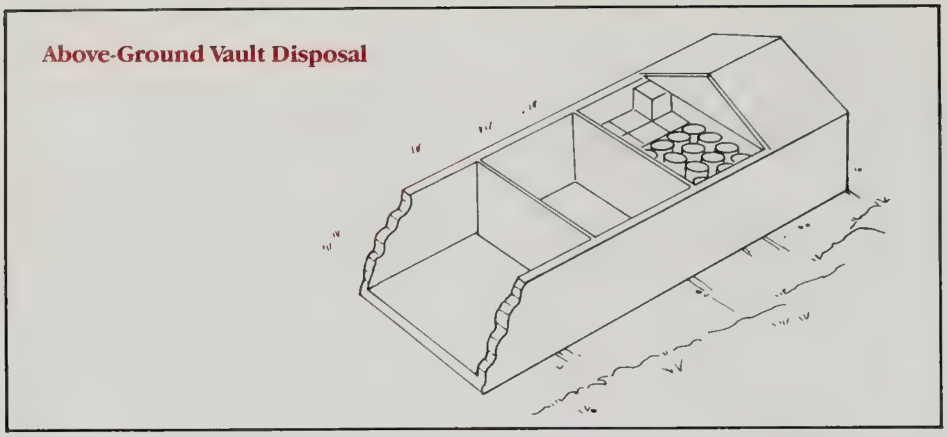

Above-Ground Vault Disposal

Figure 2

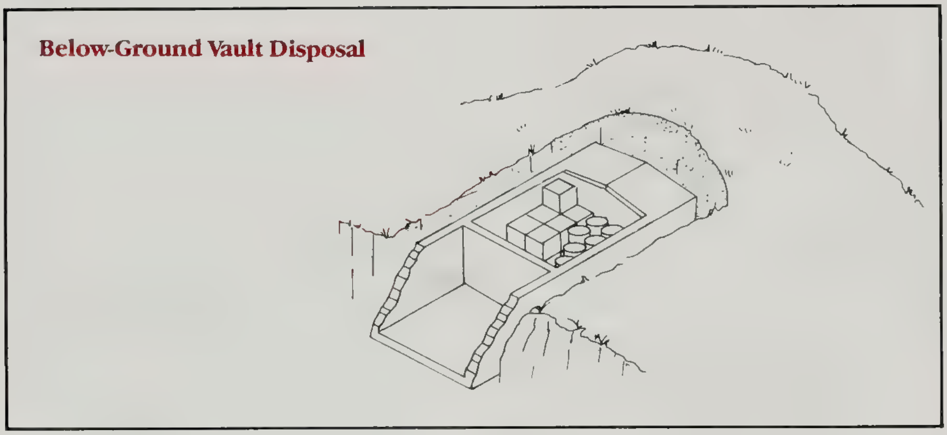

Below-Ground Vault Disposal

Figure 3

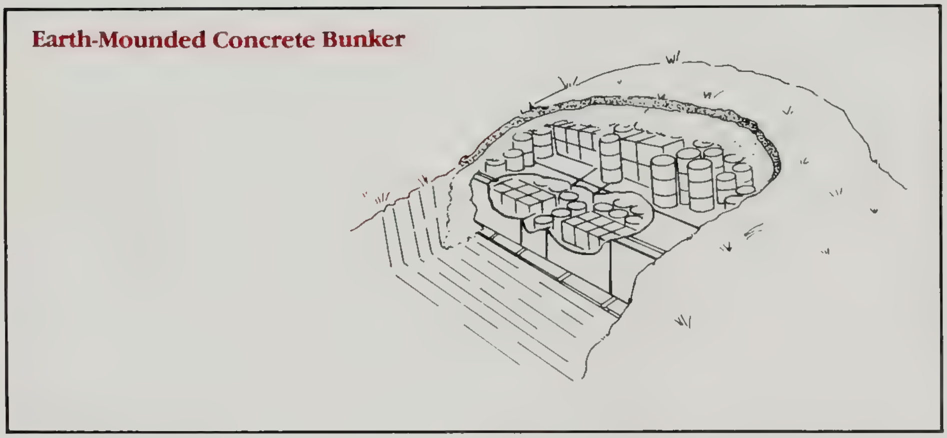

Earth-Mounded Concrete Bunker

Figure 4

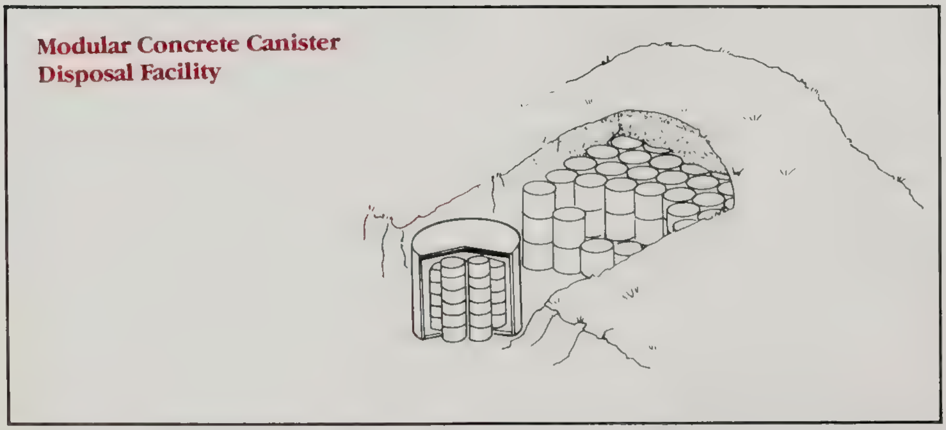

Modular Concrete Canister Disposal Facility

Figure 5 (courtesy of League of Women Voters of Illinois)

to conduct siting and characterization studies by providing statewide maps on those factors critical to a safe site," explains Dr. Richard Berg, Environmental Geologist with the Geological Survey. "That included maps on aquifer distribution at various depths, the locations of water supplies and lakes and streams, alluvial deposits, sand and gravel resources, coal reserves, inactive faults and other areas of public interest. It was a first step to developing those factors that might exclude an area from consideration site or make other areas more favorable."

Illinois has advanced rapidly in the site selection process partly due to the availability of statewide and county level data from the state's Geographic Information System (GIS) and the work of the Surveys, according to Dale Egner, Program Manager for Battelle. The GIS, housed in Champaign, is a computerized data base containing extensive information on the state's natural resources.

On June 1, 1987 DNS contracted with Battelle Memorial Institute of Ohio to assist in the site selection process. Battelle Columbus was brought in to assist with environmental studies, and Hanson Engineers, Incorporated of Springfield was added to perform geotechnical field work. Originally all 102 of the state's counties were fair game for site consideration. That list quickly narrowed as northern Illinois' counties were eliminated because of their large population centers and abundant high-yielding aquifers. An additional 20 southern Illinois counties were eliminated because of their seismic risk potential.

DNS put out a kind of informal request for proposals to all counties asking them to notify DNS if they were interested in learning more about the facility and its potential economic benefits. Based upon response to that request and preliminary data on those counties that had geologically and hydrologically acceptable conditions, the list was narrowed to twenty-one counties.

Carroll, Cass, Clark, DeWitt, Ford, Marshall, Menard, Peoria, Sangamon and Vermilion counties indicated an interest in learning more about the site. Eleven other counties took steps to opt out of consideration because of negative citizen reaction: Bond, Champaign, Cumberland, Effingham, Fayette, Gallatin, Greene, Iroquois, Knox, Logan and Piatt. Carroll and Gallatin were subsequently dropped from the list due to technical deficiencies identified by Battelle's preliminary review.

Battelle and the Surveys are now involved in the site identification process: using the GIS, other state data bases and relevant statutes and regulations to identify potential candidate areas.

Presence of one of the following factors eliminates a candidate area from selection: areas with free-standing water, areas of significant earthquake intensity, designated federally-protected lands, designated state-protected lands, areas prone to landsliding or subsidence, and areas within 100-year floodplains.

Areas with no exclusionary factors present are then subjected to a favorability analysis, consisting of seven factors drawn from county-wide GIS maps. These include: low soil permeability, simple geological structure, absence of surficial sand and gravel deposits, areas with low erosion, areas not in watersheds of surface water supplies, absence of high groundwater yield aquifers, and absence of shallow aquifers. To date 34 areas have been identified as candidates by this process.

"Other favorability factors will be investigated at the site-specific level when we have identified the candidate areas," Dale Egner of Battelle explains. "That includes 11 more factors — such conditions as presence of coal, oil or gas; critical habitats; presence of prime farmland; archaeological or historical sites; closeness to LLW generators and many others. We will use these factors to narrow down the candidate areas to approximately eight potential alternative sites. Our next step involves field reconnaissance. We want to see the potential sites first-hand, drill bore holes at each of the eight sites to confirm our mapping data, and obtain more local information. We have the potential candidate areas fairly well-mapped and we'll soon have about eight sites that will need further investigation."

Down to Four

After additional modeling and field reconnaissance, the list of potential alternative sites will be reduced to four alternative sites and the 18-month process of site characterization begins. Battelle and Hanson must obtain firsthand geological information by drilling several bore holes at each site and by conducting pump testing to evaluate the hydrogeology of the alternative sites. Groundwater and a site's impact on groundwater are paramount considerations.

Concurrent with this effort, Battelle will be conducting environmental studies on each of the four sites. The Illinois State Museum, Illinois Department of Conservation, the Surveys, and agricultural offices will all provide data for the environmental reports.

More than 100 workshops and meetings have already been held with local officials and other interested groups to discuss the site selection process. Public education efforts move into high gear after the four sites have been identified. A negotiation process goes along with that effort, as local governing groups help identify design choice and economic benefits to be included in the site selection package.

This 18-month process is expected to begin in the spring of 1988 and be completed by fall of 1989, at which point Battelle will submit a list of four fully characterized sites to the Director of DNS. The Director has the unenviable task of choosing one of those four as the final site. The Department of Nuclear Safety then moves into the licensing phase, selecting a contractor/developer who must work with local officials in design negotiation and eventually submit a licensing application to DNS. One full year of environmental baseline data must also be developed for the site chosen.

A Matter of Local Importance

As complicated as the technical studies are surrounding site selection, they pale in comparison with finding a site that is politically acceptable. Under Illinois House Bill 717, which passed the legislature last fall, county boards or city councils must agree to accept a low-level facility before it can be licensed to operate by DNS. Local disapproval must rest on sound technical considerations. The site selected is subject to appeal to the Illinois Pollution Control Board by local officials or by DNS.

Counties are being offered several economic benefits: construction jobs in building the $15 million facility, 80 to 100 permanent on-site jobs, local waste surcharges generating up to $1 million per year, property taxes and training of local residents for the site's jobs. Other state guarantees include providing assistance in meeting the site's operational demands on roads, schools, and other traditional municipal services; maintaining current property values of nearby residents or purchasing the property; establishing strict site closure guarantees to be funded from a perpetual care fund; and implementing a cradle-to-grave tracking system for LLW.

Local officials will also have a voice in determining facility design, as well as other aspects of site operation, including monitoring methods. Again, environmentalists have voiced concern that the best technically available site be chosen, even if that means some tough political decisions.

To assist local officials in making an informed decision, DNS and the Central Midwest Compact are making grants of $50,000 and $100,000 available to the governing bodies of each of the four site finalists. There is also a citizens' advisory group consisting of 17 members from the public including waste generators, environmentalists, radiologists, farmers, hospitals and others to advise DNS throughout the entire siting process.

According to Terry Lash, Director of DNS, "I am committed to not selecting a site in the face of local opposition. It is possible that no county will want the site, at which point we have to go back to the legislature. It may ratify our choice or it may send us back to characterize additional sites. We are still optimistic. There are still many counties not opposed to a site, who are still talking and negotiating with us. No one has said they really want it. On the other hand, we have a lot of groups out there willing to keep an open mind. That's all we ask."

DNS Timetable for An Illinois Low-Level Waste Site

January 7, 1988	DNS announces candidate areas
March 1988	Eight potential sites identified
April 1988	Announcement of four alternative sites; site characterization begins
Fall 1989	Battelle submits fully-characterized profiles of sites to DNS
1989-1990	One site selected
1990	Application for licensing submitted to DNS by facility developer
1991-1992	Site construction
1993	Disposal facility comes on-line and accepts waste

Candidate Areas Chosen by Department of Nuclear Safety

The Department of Nuclear Safety had identified 60 areas in 17 counties as potential candidate areas for siting. Since the accompanying article was written, 29 candidate areas in eight counties with the following distribution are now under active consideration.

Cass (2); Clark (5); DeWitt (4); Ford (2); Marshall (1); Menard (4); Sangamon (5), Vermilion (6).

Shiitake

From low-value hardwood logs come great-tasting high-value ($6 a pound and up) edible mushrooms. Balancing business and nature is the message Dr. Chris Burnett of the Illinois Natural History Survey (NHS) is preaching to farmers and small landowners, all potential growers of shiitake mushrooms.

A Samurai's Delight

Shiitake (pronounced shē-ē-tâh-kay) has been cultivated in Asia for centuries. Shiitake is the Japanese name for this highly-prized mushroom, also called *Dong* by the Chinese and *Huang Skin* by Koreans. Shiitake means mushroom of the *shia* tree, which is related to the oak. The first written reference to shiitake was in the 1600's, although it was probably cultivated for centuries before that.

It was valued both for its taste and for its medicinal properties. Like ginseng, shiitake was thought to cure ailments associated with old age and to have aphrodisiac qualities. The shiitake was so highly prized in Japan that samurai who knew where the mushroom was grown would threaten anyone who attempted to trespass.

The shiitake was originally harvested from the wild. It wasn't long before logs bearing the mushroom were hauled into courtyards, and domestic cultivation began. In 1942 Kisaku Mori, an agriculture student at Kyoto University, discovered that the fungus could be grown on presterilized wood chips. Pure cultures of the fungus could then be inoculated directly into holes drilled in logs.

Shiitake

Shiitake is Japan's leading agricultural industry, employing over 180,000 people and generating over $1 billion in retail sales annually. The United States imports over $100 million per year in shiitake, making this country Japan's third best customer in shiitake sales. A market exists here for growing shiitake, according to the U.S. Department of Agriculture: a $2 million annual market in this country now and a potential $20 million market in the future.

The shiitake was so highly prized in Japan that samurai who knew where the mushroom was grown would threaten anyone who attempted to trespass.

The Oak Mushroom

Shiitake did not make its appearance in the United States until 1974, when Dr. Fred Howard and R.M. Hoffman established the Mushroom Research Institute in California. They produced shiitake mushrooms within four months. A scant year later Dr. Byong Yoo began his domestic experiment in shiitake by inoculating a cord of oak logs in a woodlot outside Washington D.C. Two years later Dr. Yoo's logs produced a bumper American crop of 110 pounds of shiitake mushrooms. There are thousands of small shiitake growers in the United States now, and 40 to 50 large growers. These large growers usually grow shiitake indoors using artificial media.

For those interested in growing their own shiitake crop, the process is surprisingly easy and not labor-intensive. The first step is obtaining viable inoculum in pure culture and then refrigerating, but not freezing it until ready for use. Domestic companies that supply spawn are limited, but there is one in Naperville, Illinois.

Selecting the right species of tree and preparing the logs for inoculation is particularly important in establishing vigorous shiitake growth. This step requires freshly-harvested (best time is late winter), low-grade hardwood logs of small diameter (2-8 inches). Shiitake will not grow on living tissue and survives on dead wood only when given a head start on competitive fungi. For that reason, only recently cut trees are used for shiitake cultivation. Oak is the preferred tree species, although shiitake also grows on other hardwoods.

The fungus is introduced to the logs via inoculation, a process that involves introducing the shiitake spawn into holes drilled in the logs within two to three weeks after felling of the host tree. Spawn plugs are placed into the holes — 20 to 50 pieces of spawn per log — spaced 8 to 16 inches apart in rows, with rows one to two inches apart. The holes are then covered with wax to keep moisture in and competing fungi out.

Turning the Logs and Turning a Profit

Laying the logs is one of the trickiest parts of the cultivation process. Dr. Chris Burnett of the NHS, along with the Vermilion County Conservation District, is currently conducting a demonstration project on shiitake mushroom production at Kennekuk Cove County Park (just north of Kickapoo State Park), and explains the process and the reasons for the Survey's involvement.

"We're looking at seven strains now; two are already producing well. We use 100 logs per strain, so we have 700 logs in various piles and configurations. We're concerned about moisture, climate and log management. The logs have to be stacked, moved and periodically soaked. The logs may also have to be covered to prevent them from receiving too much sunlight or becoming dehydrated."

"My interest is in showing that growing shiitake is an economically viable opportunity as well as sound environmentally. People will probably grow shiitake anyway, but we don't want them cutting down just any oak. We want to educate them on woodland management. The logs you need for shiitake cultivation can be low quality and only four to six inches in diameter. That means that the trees that should be used are the ones that would be thinned in forest management anyway or the tops of trees felled for timber. The whole idea is to complement the management of established timber stands *and* increase the feasibility of restoring woodland cover to marginal croplands."

The Fruit of the Oak

Shiitake is capable of fruiting only after the logs have been completely colonized by the fungus. This process takes six months to two years. The logs are "raised" in a configuration that favors abundant moisture, good air movement and shaded exposure to light. Cool temperatures — 46 to 72 degrees fahrenheit — are best. Fruiting occurs in spring and autumn, the wet cool seasons. Raising the logs is also helpful in harvesting the crop. After mushroom formation begins, shiitake is often ready to be picked in two to seven days. Fresh mushrooms should be stored refrigerated in trays with slots for ventilation. Shiitake can also be dried using heated forced air chambers or an inexpensive alternative for the small grower — the sun.

"There's a lot more flavor to the shiitake mushroom than there is to the standard button mushroom most of us are familiar with," reports Dr. Burnett. "The shiitake has a meatier, more substantial texture. The mushrooms are a good source of B and D vitamins. Some early research indicates that eritodenin, a substance found in shiitake, reduces cholesterol. Other studies as to its medicinal properties are underway."

"I got involved in growing shiitake because it fits in with what I am trying to do as a wildlife ecologist. Wildlife can take care of itself if it has suitable habitat. Rather than studying wildlife, we need to study people and the ways they can work the land without destroying the habitats of the native flora and fauna. Agriculture and wildlife preservation are not mutually exclusive goals. Shiitake production can help farmers who would like to grow trees on marginal cropland. Most timber takes 40 or more years to mature. How can I convince farmers that that's economical? But a farmer can harvest trees for shiitake in ten years. He's preventing farmland erosion, providing wildlife habitat and growing another profitable crop."

Dr. Christopher Burnett is an Assistant Wildlife Ecologist and has been with the Natural History Survey's Wildlife Research Section for the past five years. He received his doctorate in Mammalian Ecology from Boston University. Anyone wishing more information on shiitake cultivation is encouraged to write to Dr. Burnett at the Illinois Natural History Survey, 607 East Peabody Drive, Champaign, Illinois 61820

Shiitake — picking stage

Shiitake Mushroom Dip

Ingredients:
4 tbs. butter
3 cups chopped onions
1 lb. chopped mushrooms
½ tsp. salt (more, to taste)
1 tsp. dry mustard
½ tsp. dill weed
black pepper, to taste
cayenne, to taste
3 tbs. dry white wine (more, to desired consistency)
8 oz. (1 cup) neufchatel or cream cheese

Procedure:
1) Sautee onions in butter until soft (5 min.)
2) Add mushrooms & seasoning, stir and cook another 5 min.
3) Add wine & cook 5 more min.
4) Blend about ¾ of cooked mixture with the cheese, adjust seasoning
5) Stir in unblended mixture

* Adapted from *The Enchanted Broccoli Forest* by Molly Katzen (1982) Ten Speed Press

Stirring Out Trouble:

Recycling Illinois' Lakes

For 40 years, Lake Eureka had faithfully provided Eureka's citizens with a good cheap source of drinking water. But since the early 1970s citizen complaints about bad tastes and odors in their drinking water had increased. Then came the winter of 1976-1977, and patience with the on-again, off-again quality of the drinking water came to a halt. Benny Arbuckle, Superintendent of City Services for Eureka, summed up everybody's frustration, "At least twice this year, for about three weeks continuously, our water tastes — and smells — just terrible. And this time it has been worse than ever."

The Aging Process

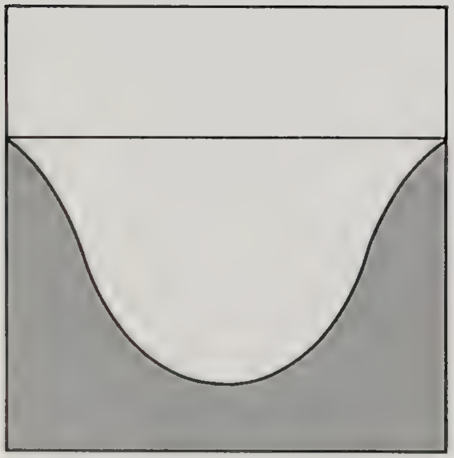
Eureka wasn't the only Illinois community suffering from lake water gone bad. Other towns and cities were wrestling with deteriorating lake drinking water and with recreational lakes covered with unsightly surface scums and dense growths of aquatic plants. Illinois' lakes are getting old, and that means a steady deterioration in water quality.

All lakes undergo a kind of aging process. Every lake, whether natural or man-made, has a life span during which it begins its existence, ages, becomes a marsh or swamp, and eventually returns to dry land.

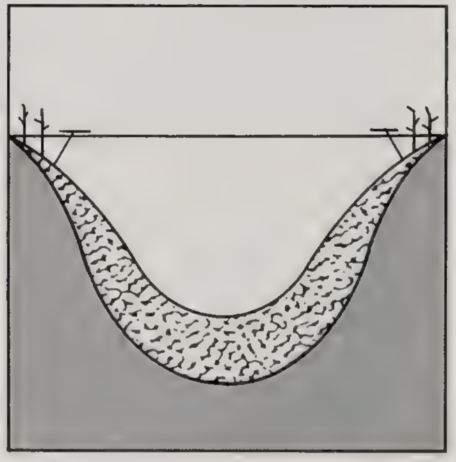
The first phase of a natural lake's existence is called the *oligotrophic* (from the Greek meaning "little nourishment"). Lake waters in this phase have high levels of dissolved oxygen, low concentrations of plant nutrients and little animal or plant life. Natural lakes are formed on infertile land that has low potential for supporting plant and animal life. Man-made lakes differ in that they are frequently created by the flooding of fertile river valleys rich in plant nutrients and thus have a large amount of biological activity in their early stages. These lakes have their own problems if fresh nutrients do not flow into them. Biological activity may decline after just a few years as the original nutrients sink into the bottom sediments.

Mesotrophic ("intermediate nourishment") describes the next stage of a lake's life. Plant nutrients from rain, melted snow and groundwater increase in the lake. These nutrients feed plants along the shore and in the water. The plants grow, and as they get larger, they begin to trap incoming sediments. The lake begins to fill in and to become shallower from the accumulated plants and bottom sediment.

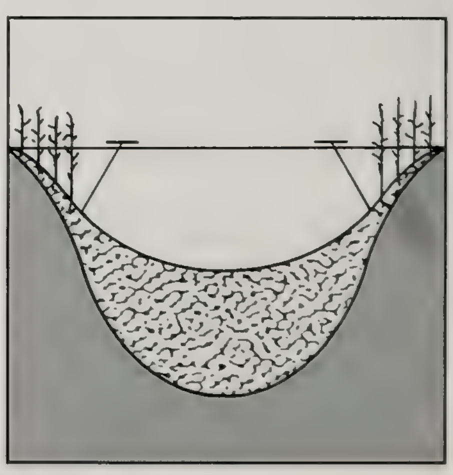
The last stage in a lake's life before it becomes a marsh or swamp is the *eutrophic* ("rich nourishment") stage. Dissolved nutrients are very high, and plant and animal life abound. The decomposition of organic life in the lake draws heavily on the lake's oxygen levels. The bottom waters of the lake, which can be completely isolated from the upper layers in the summer, may have



Oligotrophic Lake



Mesotrophic Lake



Eutrophic Lake

no oxygen at all. The lack of oxygen in the bottom waters leads to biochemical reactions in the bottom sediments, which in turn lead to the release of nitrogen, iron, manganese, phosphorus, hydrogen sulfide, methane, and other substances.

The external symptoms of lake eutrophication are prolific weed growth, large masses of algae that create surface scum, fish kills and even more rapid accumulation of sediments.

Too Much Nourishment

The problems caused by eutrophication are many. The waters used for public supplies are most often taken from the bottom of the lake, yet that is where substances like iron, manganese and hydrogen sulfide are found. And those substances are responsible for the unpleasant odors and tastes which can be difficult and costly to remove. Color, taste and odor problems are exacerbated by excessive plant growth in eutrophic lakes. This plant growth can also clog filters in the water treatment process.

■

All lakes undergo a kind of aging process. Every lake, whether natural or man-made, has a life span during which it begins its existence, ages, becomes a marsh or swamp, and eventually returns to dry land.

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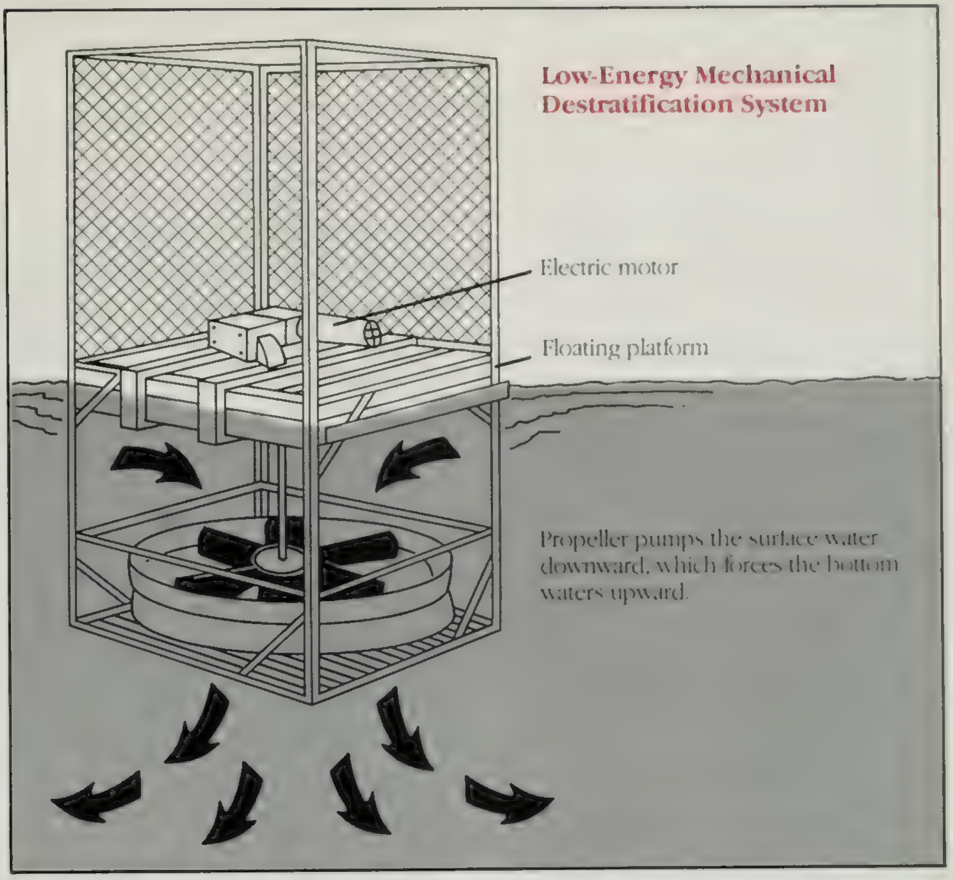
Spoiled drinking water isn't the only problem. For those lakes used for recreational purposes, fishing may be hampered as sports fish give way to fish that can tolerate low oxygen levels. Organisms that serve as food for fish give way to sludge worms. Fish populations become restricted to limited areas and fish kills may result. Blue-green algae becomes the predominant form of algae. This algae has gas pockets which float on the surface, creating unsightly surface scums. Some of these algae also have toxic effects on certain fish and animals and cause skin irritations and gastrointestinal disturbances in humans.

Recycling A Lake

There are two methods of lake restoration. The first involves preventive measures to reduce the amount of nutrients and sediments that flow into a lake. These include restricting the types of activities in the lake's drainage basins. Large-scale farming, land development and logging lead to soil erosion and an influx of sediments and nutrients into a lake. Another preventive measure is diverting the effluents away from a lake. This is especially helpful where sewage effluents have been the primary factor in eutrophication. A third preventive measure involves using the wastewater treatment process to reduce nutrient process loads in waterways.

The second method of lake restoration relies on in-lake measures that may bring about immediate improvement. In-lake measures are usually the most cost effective, yielding the maximum benefits for the least amount of money.


Low-Energy Mechanical Destratification System
Electric motor
Floating platform
Propeller pumps the surface water downward, which forces the bottom waters upward.

A Case Study: Restoring Lake Eureka

Back to Lake Eureka. The taste and odor problems in the lake's water had grown so bad that the city switched to ground water as its water supply. That switch led to another set of problems. Dr. Raman K. Raman of the Illinois Water Survey (IWS) describes those problems: "The use of groundwater as a source increased pumping, chemical and treatment costs. And since the water treatment plant had not been designed to treat groundwater, a number of operating and maintenance problems developed."

The IWS solved Lake Eureka's problems with a destratifier used in conjunction with chemical control of algae. A destratifier mixes the lake water at all depths. This brings oxygen to the bottom waters and eliminates the separation of water into layers with distinct temperatures, a process that occurs during the summer and winter months.

The mechanical destratifier used in Lake Eureka is a low-energy axial flow pump with a six-foot impeller driven by a 1.5 horsepower motor through a gear reduction box. The system is supported by a floating platform with the impeller mounted at five feet from the water surface. The impeller rotates at 36 r.p.m., forcing the oxygen-rich surface waters downward. This in essence mixes the waters and the oxygen.

One year after the 1981 installation of the destratifier, the City of Eureka again began using Lake Eureka as its main source of drinking water. The destratifier continues to be used each winter and summer season. Overall savings to the community in power and chemical costs amount to $40,000 per year. In addition, operational problems within the treatment plant have been eliminated or minimized.

"The water supply system at Eureka

works very well. There have been no consumer complaints about taste and odor in the finished waters. We found that the destratifier maintained adequate levels of oxygen throughout the waters of Lake Eureka," reports Dr. Raman. "Reductions of about 90, 95, 98, and 50% in the mean values of ammonia-nitrogen, iron, manganese and chlorine demand were achieved, and blue-green algae have never been dominant in the lake since destratification began. Algicide applications have not been required in the lake since 1984."

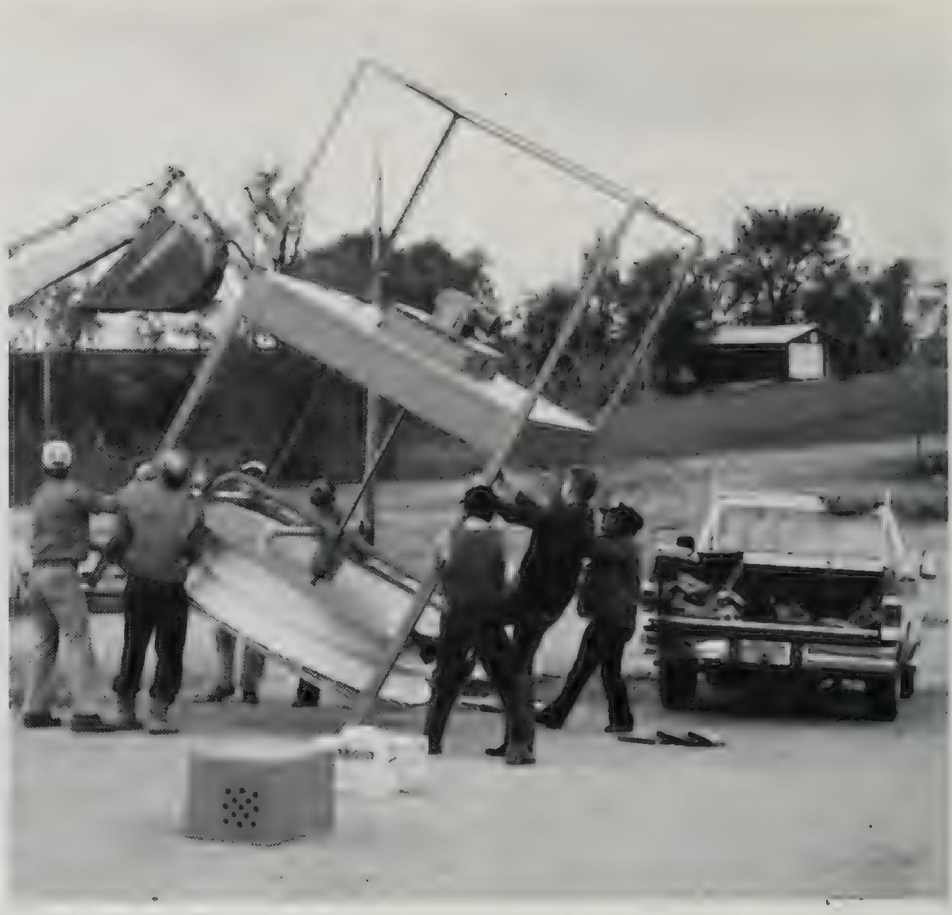
There have been similar IWS success stories using destratifiers in recreational lakes. One such lake was Lake of the Woods in Champaign County, used both for recreation and irrigation of an adjacent golf course. The problems were similar: unsightly algae, aquatic weeds, poor fishing, unclear water, silting, etc. Chemicals had been applied, but this led to concern about the effects of those chemicals on swimmers, fish and turfgrass.

Once again, lack of oxygen in the bottom layers of the lake was the culprit. One-fourth to one-third of the total lake volume was unsuitable for fish and other aquatic life. Again, destratification was the answer. Since a destratifier was installed, the water in Lake of the Woods cleared considerably and there was a decrease in algal blooms and aquatic weeds.

The in-lake water quality management techniques developed for Lake Eureka have since been successfully adopted in several other impoundments in Illinois (see Figure 1). All the lakes except Lake Catherine and Lake Canton employ mechanical destratifiers. An aspirated air aeration system is used in Lake Catherine and a diffused air aeration system is used in Lake Canton. Of the 12 lakes treated, seven are water supply impoundments and the remaining five are recreational lakes.

"All the lake and water treatment managers expressed great satisfaction with the systems," Dr. Raman reported. "Odor and taste problems have been effectively controlled. Our costs in developing these systems have been minimal, involving only travel and material costs. And, as in the case of Lake Eureka, the costs incurred should be recovered within one year."

Dr. Raman K. Raman is the Head of the Water Quality Section at the Illinois Water Survey. He has been a Principal Scientist with the Survey since 1968. Dr. Raman graduated from the University of Illinois with his Ph.D. in Civil Engineering.



Lake Eureka destratifier prior to its installation.

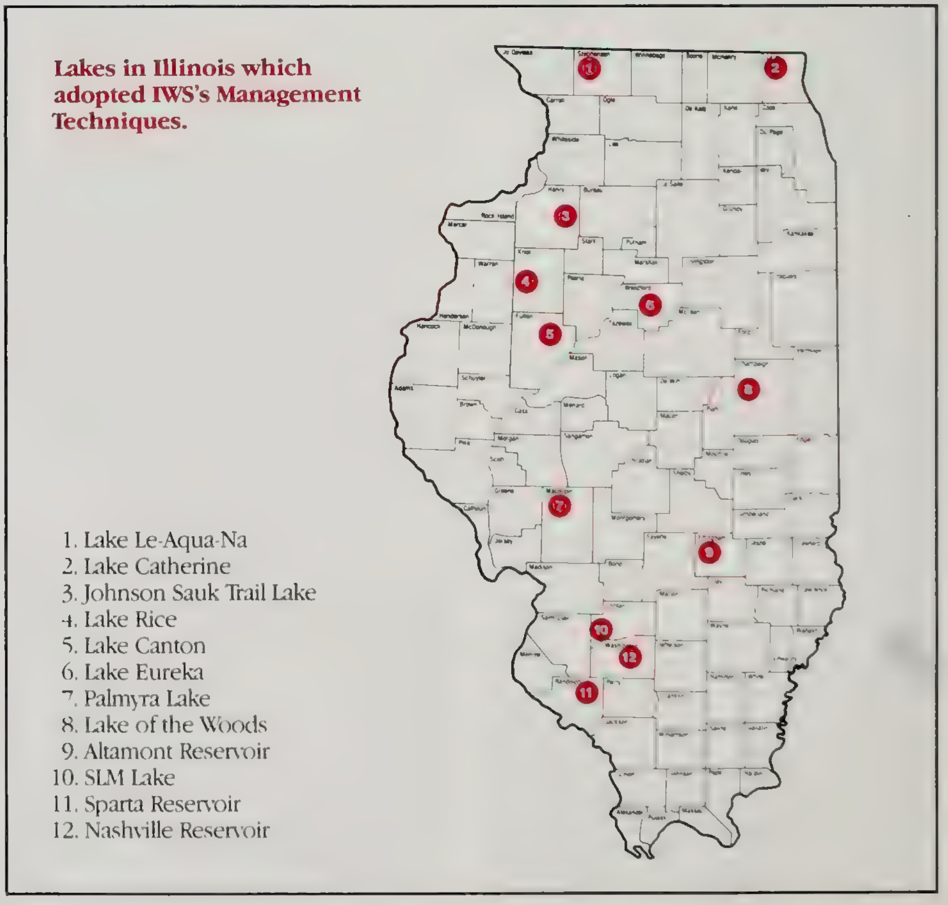


Figure 1

Answering the Geophone

In the good old days of elixirs and patent medicines, charlatans and con men used forked sticks, usually made of hazel and called divining or dowsing rods, to "locate" underground water. More often than not what they located was P.T. Barnum's proverbial sucker and his wallet. In these days of scarce water, science has taken over.

Unlike Chicago and surrounding areas that draw down their water from Lake Michigan in a complicated allocation system, Kane County and other collar counties historically have relied on deep wells for their water supplies.

This source of water is literally drying up as demand for water increases. The wells of these communities, 1,200 to 1,400 feet deep, suffer from overpumping and deteriorating water quality. County officials discovered to their dismay that additional deep wells were not the answer. In Kane County these deep supply wells produce groundwater that exceeds the U.S. Environmental Protection Agency's standards for dissolved radium and, in some areas, barium. These substances are not the result of contamination, but instead occur naturally in the area's aquifers. Another solution, transportation of water from Lake Michigan by pipeline, was rejected as too costly.

A ray of hope did exist for municipal officials in *shallow* groundwater resources, found in shallow dolomite bedrock and sand and gravel deposits in the glacial drift that overlies the bedrock. Shallow wells drilled as close as 100 feet below the surface would avoid the radium and barium typically found at deeper levels and would have lower production costs in terms of the electricity needed to bring the water to the surface.

Concern over stewardship of their groundwater resources led Kane County and city officials into a partnership with the Illinois Geological Survey (IGS) and the Illinois Water Survey (IWS) to evaluate shallow groundwater resources in the area.

A Solution Surfaces

The geology of northeastern Illinois is complex. Continental glaciers modified and buried the preglacial landscape. Shallow bedrock in the region is dolomite and shale. This bedrock is overlain by glacial materials deposited from one million to about 10,000 years ago. These glacial deposits contain clay, silt, sand and gravel. Etched into the bedrock are hidden bedrock valleys filled in with these glacial deposits. The valleys are useless as aquifers if they are filled with clay: water won't flow through clay. But if the valleys are filled with sand and gravel, they are full of fresh water. The problem is finding these buried shallow bedrock valleys and then pinpointing the ones with glacial sand and gravel. Unfortunately aquifers in northeastern Illinois are not uniformly distributed.

> **Etched into the bedrock are hidden bedrock valleys filled in with these glacial deposits. The valleys are useless as aquifers if they are filled with clay: water won't flow through clay. But if the valleys are filled with sand and gravel, they are full of fresh water.**

The first step researchers took was to look at regional water well information already available, and that led to the first stumbling block. An early environmental mapping program conducted by IGS Geologist Bob Gilkeson in 1975 and 1976 found that drillers had cited erroneous locations for a large number of the water well records on file for Kane County. An intensive program was initiated by the IGS and Kane County to cross-reference records and provide an accurate regional picture of water wells. Since 1976 an ongoing program has been maintained to verify the locations of new water wells drilled in the county.

Once IGS scientists were sure they had an accurate data base, they were able to determine that significant shallow groundwater resources were indeed present in the county. The next phase of the project focused on where and how extensive those resources were.

Drilling costs could amount to $5,000 per test well. If drilled randomly to locate the aquifer, drilling costs would be prohibitive. To reduce the number of test wells needed and associated costs, IGS scientists used two surface geophysical methods to map the regional distribution of sand and gravel deposits in the glacial drift and locate the most promising areas for shallow aquifers.

A Network of Hidden Bedrock Valleys

The first method employed by the IGS team is called seismic refraction. An electrical line is laid out on the ground. Geophones, which are four to five inches long and look like spikes hammered into the ground, are spaced along this line. Dynamite is placed in holes four to five feet deep and then set off. Sound waves from these explosions travel through the ground and strike bedrock and glacial materials and then bounce back to the geophones embedded in the surface. The geophones measure the travel time of the sound waves. The scientists already know sound waves generally travel at a faster velocity through bedrock than through glacial materials in this area. The more time it takes for the sound waves to travel back to the geophones, the thicker the glacial materials are.

From these soundings researcher

are able to map the top of the bedrock profile and determine where the thicker glacial materials lie. Once those deposits and a hidden bedrock valley are found, water may be at hand. The research team still needs information on what type of materials are in the valley.

The second surface geophysical method, electrical earth resistivity, is used to investigate the presence of sand and gravel in the hidden valleys. Once again an electrical line is laid on the ground with electrodes placed in the ground at various distances. An electric current is sent through the ground and a wire is hooked into a meter that measures resistivity.

In freshwater environments, sand and gravel deposits have a higher resistance than clay-rich fine-grained deposits. Earth resistivity studies provide data on which areas are likely to contain freshwater-bearing sands and gravels and which are likely to contain clay. The very best find for water-seeking geologists is sand and gravel deposits full of water but with a clay confinement. The clay confinement protects the aquifer from surface sources of contamination.

The IGS team put down 100 miles of seismic line through Kane County after identifying promising areas in the region. All of the county is being mapped, but the eastern one-third was specifically targeted because of large population centers in need of water. The researchers found some buried valleys that traveled all the way across Kane County. The valleys were usually long and narrow, one-quarter to one and one-quarter miles wide. The search yielded several possibilities for city and county planners.

Well Fields and Aquifer Tests

After more detailed seismic studies were conducted, city and county officials identified areas that they wanted to look at further. The cities contracted with private well-drillers using locations supplied by IGS personnel. Twenty-five to thirty test wells were sunk in Kane County since September of 1983 for the cities of Aurora, Geneva, Batavia, St. Charles and Montgomery, and more test wells will be drilled in the future. These test wells confirmed the geophysical findings of the IGS staff.

Energy is being put into the ground by the Geological Survey's "thumper". The geophone, placed next to the street, is picking up the signal and transmitting it to the seismograph.

The next step brought in the expertise of the Illinois Water Survey (IWS) to conduct aquifer tests. In these tests a well is drilled that pumps water out. A series of observation wells are then drilled to monitor water levels in the aquifer while the first well is being pumped. These tests give information on the yield of the well: how many gallons per minute (gpm) of water the well can be expected to yield. They also tell researchers how closely the wells can be spaced so that one does not interfere with another. Just as importantly scientists want to know if the aquifer is recharging. As the water is pumped out of the well, is the aquifer refilling with water so that with long-term use water levels do not drop below critical levels?

To date the IWS has conducted six aquifer tests: three at sites in Aurora, two for the city of Montgomery and one for Geneva. Yields from these wells have run from 400 gpm at Montgomery to 1500 gpm at the Geneva site.

According to Stephen McFadden of the IGS, "The costs of pumping and treating water from shallow aquifers is approximately one-half the price of using deep well water and one-quarter the price of piping in Lake Michigan water. Aurora, Geneva, Batavia and Montgomery will all be using these wells as part of their municipal water supply systems. I think people up there weren't convinced at first that shallow water resources were going to do them any good. This was really a pilot project. I think we've convinced them that shallow groundwater is a significant resource; that it is possible to find that water and use it. We're already hearing from other communities around the state about their water problems."

This article is based on the work of Stephen S. McFadden, an Associate Geologist in the Groundwater Section of the Illinois Geological Survey and Robert Gilkeson, a former Geological Survey staff member. Mr. McFadden has been with the Survey since 1986. His research interests include aquifer mapping and quantitative analysis.

Also contributing to the shallow groundwater project is Adrian Visocky, a Hydrologist at the Illinois Water Survey. Mr. Visocky's research interests include groundwater resource assessment, hydraulics of deep-well waste injection, natural recharge of groundwater systems and groundwater management.

SURVEYING ILLINOIS

WILDLIFE

Eye of Newt . . . Wool of BAT

Bats are flying rats. Bats are blind. Bats attack people, and they like to fly into women's hair. Bats are filthy, disease-ridden and they carry rabies. Bats suck human blood.

No, and no again. Contrary to every belief commonly held by western culture, bats are among the most beneficial creatures in all nature. In other cultures bats are revered and made symbols of good fortune. The Chinese word for bat is *fu;* the same word meaning happiness and good luck. A favorite Chinese design called the *wu-fu,* consisting of a disk enclosing the symbol of life surrounded by five bats with spread wings, was incorporated in royal treasures. The design symbolizes the five great blessings desired by all: health, wealth, long life, good luck and virtue or tranquility.

According to Muhammadan legend, Christ personally created bats during a fast among secluded hills, to apprise him of the time between sunset and sunrise. In Central America, the bat god was a powerful deity of the Mayans. And current-day Britons have become champions of the bat: joining bat conservation groups, hanging bat roosting houses in their gardens and even refurbishing an old Victorian mansion in Gloucestershire solely for an endangered colony.

Why has there existed such a batlash against these warm-blooded mammals, who share as much with humans as they do with rodents and birds? As part of a western culture, descendants of Old World Europeans, we have been conditioned over the centuries to associate bats with superstition, magical ingredients and evil doings, *viz* Shakespeare's weird sisters. All of this nonsense may go back to the early 1400's when Vlad the Impaler terrorized his Transylvanian kingdom earning him the Romanian nickname "Dracula", meaning "son of devil." Thus begun the legend of Dracula the vampire, a blood-thirsty fiend who turned into a bat and flew through the night sky in search of a virgin's neck to pierce with his blood-sucking fangs.

No one understands how Romanians thought up a vampire bat which feeds on blood. Bats do live in Romania, but they eat only insects there. The blood-feeding bats (which do not suck blood, but merely lap it from an incision they make in the skin of animals) live only in tropical America. And America was not discovered by Europeans until 1492. There are three species of vampire bats, but even these species were not discovered and described until many years after that

The Truth About Bats

Bats are neither flying rodents nor are they birds. They are tiny, secretive, warm-blooded mammals active only at night. The scientific classification of bats places them in the order "Chiroptera", meaning hand-wing. A bat's wings are made of a double layer of elastic skin stretched between elongated fingers. Bats were well-developed over fifty million years ago, when horses were just evolving. Bats are totally unlike rodents except that they are small and furry and may slightly resemble rodents in facial features. Unlike rodents, bats usually only have one young per year.

Bats are not blind. Some bats see better than others, and like many other forms of wildlife they do not see color. Bats do use a very sophisticated form of radar called echolocation for moving about and feeding. Bats have played a special role in space biology, with studies of bat sonar leading to the development of navigational devices for the blind and sonar used in military defense.

Bats do not attack people, and do not normally become entangled in women's hair. Imagine a creature capable of detecting insects smaller than mosquitoes blundering into a woman's hair. Bats are attracted at night by the insects that are attracted to boat lights, and fishermen may have misinterpreted their motives. Bats are very secretive, and they don't even like being around people. They colonize caves, hibernate and would prefer to be left alone.

Bats are not filthy and disease-ridden. They are very fastidious animals, continuously grooming themselves, their offspring and their neighbors. Bats do have parasites, like all mammals, but these parasites are so specialized that they pose no health hazards to humans. And bats do not carry human bed bugs.

A special word about bats and rabies. Rabies does occur in bats, as in many other mammals, but at a very low incidence, according to Illinois Natural History Survey (NHS) researcher Dr. Chris Burnett, who has been conducting a 22-year study on bat rabies in Illinois. Only ten people in the United States and Canada are believed to have gotten rabies from bats in the last four decades. There are two forms of rabies, one called the "mad" form, in which the animal is aggressive. Bats suffer from the other form, the "dumb" form of rabies, which debilitates the animal. Most bats are not aggressive, reports Dr. Burnett. The important thing to remember is to stay away from any animal that appears to be ill. This caveat is important for your health and the bat's. Bats may be ill or they may simply give the appearance of being ill.

To conserve energy bats drop their body temperature a great deal because they are so small that it is hard to keep their temperature up. Some bats can even hibernate at will. What looks like a sick bat may simply be a torpid bat that is perfectly all right. Once you disturb the bat, as human cave explorers are wont to do on occasion, temperature jumps up, metabolism speeds up and the bat ends up losing valuable fat reserves. The bat may not make it through the winter.

The Bat Qua Bat

Bats have successfully colonized every continental region in the world except the most extreme desert and polar areas. There are nearly 1,000 species worldwide, comprising the second largest order of mammals in number of species, second only to rodents. Bats represent one-fourth of all mammal species on earth. In the tropics that number jumps to half. There are 40 bat species in the United States, and 12 species that commonly occur in Illinois. About the vampire bats — there are exactly three such species, all living in Latin America.

Bat size ranges from extremely small to the large flying foxes of Africa, Asia, Australia and many Pacific Islands. The world's smallest mammal is the Kitti's hognosed bat in Thailand, weighing less than a penny (less than one-tenth of an ounce) with a body roughly the size of a bumble bee. Flying foxes can weigh more than two pounds and have wingspans up to six feet. Bats eat insects (approximately 70% of all bat species in the world are insectivorous), fruit, leaves, flowers, nectar and pollen, fish, other vertebrates (rats, small lizards, frogs) and animal blood.

The Bat As Bug-Zapper

In the bat, nature devised a ruthless and effective insect killer long before insecticides and electric bug-zappers were invented. Bats are the only major predators of night-flying insects. One endangered gray bat (found in Illinois by the way) can eat up to 3,000 insects in one night. The little brown bat, a species common to Illinois, can devour over 140 mosquitoes in less than 15 minutes and up to 900 insects within an hour (including harmful corn borer and cutworm moths). A colony of free-tailed bats in Texas chows down on more than 250,000 pounds of insects nightly.

Good eyesight isn't enough when you're after a gnat in pitch-black darkness. One reason bats may have evolved their wonderful system of sonar is as a weapon in their war on night-flying insects. During flight, the bat emits high-pitched sounds and listens for the echo — thus homing in on the evening's meal.

Bats and the Fruit Stand

No, we're not talking about bat guano here, although that is another bat benefit we'll talk about later. Fruit-eating bats are among nature's most important seed-dispersing animals. Nectar bats are essential for the pollination of countless tropical and sub-tropical trees and shrubs. Without the bat, no rain forests. And without the rain forests, less oxygen and unstable climates would result.

More than 130 genera of tropical trees and shrubs depend on the bat for pollination. The fruit stand wouldn't be the same without bats: no bananas, mangoes, guavas, plantains, breadfruit, figs, avocados, cashews, cloves or dates. Durian fruit from Southeast Asia, worth $90 million annually, could not be produced without being pollinated by a single species of bat. In Malaysia, bat guano fertilizes almost one-third of the world's supply of black and white pepper.

Other non-food items depend on the bat for production: tequila (agave plant), chewing gum (chicle latex), candy (carob), rope (manila and sisal fibers), bandages and life preservers (kapok fiber), Iroko lumber from West Africa, balsa wood and other timber-producing trees used in the manufacture of furniture.

Eastern Pipistrelle

And then there are the bat's medical contributions: Research on the bat has led to the development of new drugs to combat high blood pressure, studies of disease resistance, progress in speech pathology, and important finds on aging and the healing process. The delayed fertilization ability of some bats has also yielded research gold in the areas of artificial insemination and birth control.

Batriotism and the Revolutionary War

During the Revolutionary War, Britain would not of course export gunpowder to the rebelling thirteen American colonies, and British blockades significantly reduced other imports. The Americans had to produce domestic supplies. This is where the gray bat comes in. Once prevalent throughout the eastern United States, these bats spend the winter hibernating in caves. They also form large colonies in caves during the summer to bear their young.

Hoary bat in flight

After centuries, millions of tons of nitrogen-rich insect remains accumulated in caves below the gray bats' roosts. Bat guano was used as a substitute ingredient in producing blackpowder, which is made from sulphur, charcoal and potassium nitrate (also known as saltpeter). Saltpeter is made by leaching bat guano, and in the eastern United States, adequate supplies of bat guano could only have come from gray bats. Gray bat guano deposits mined for saltpeter in Mammoth Cave, Kentucky, date back over 34,000 years.

Illinois' Bats

The 12 native bat species of Illinois range in size from the one-fifth ounce eastern pipistrelle to the one and one-half ounce hoary bat. The most commonly encountered Illinois bats are the red bat, the little brown bat and the big brown bat. The latter can be seen around street lamps during the summer months feeding on insects; all Illinois bats are insectivorous. The most rarely seen Illinois bat is the big-eared bat with ears over one and one-quarter inches long. All Illinois bat species are protected by law. However, two species are classified as federal and state endangered: the Indiana bat and the gray bat. The Indiana bat once numbered in the millions but is now down to a mere 230,000.

The first colonies of Indiana bats found in Illinois were discovered in 1986 by Gene Gardner and Dr. Joyce Hofmann of the Natural History Survey and Jim Garner of the Illinois Department of Conservation (DOC). After an extensive three-year survey of 900 plus trees, the bats were found in a dead northern red oak and a dead cottonwood, both located near a stream in west-central Illinois. There are not many bat-suitable caves in Illinois (four out of 360), and so the Indiana bat population in Illinois during the winter is small compared to those of neighboring states. However bats do migrate to Illinois from Missouri and Indiana to form maternity colonies beneath the loose bark of trees like the ones found in the NHS-DOC cooperative study.

The task of finding more bats got a little easier with the use of radiotelemetry, a never-before tried technique with this small a bat. Tiny transmitters half the size of a dime and weighing less than .03 ounces were glued to the bats, allowing them to be followed with antennae and tracking receivers. The researchers found 26 more trees in 1987, some with maternity colonies, some with only male bats, in five counties: Pike, Adams, Johnson, Jackson and Macoupin. The research team is now plotting out large amounts of data to obtain a fuller picture of the bats' summer home range, size, foraging range, nightly movements and essential habitats.

The picture for the gray bat is encouraging, according to Gene Gardner. Through protective management, they are making a comeback, and in the near future may be upgraded from endangered to a less serious threatened status. The outlook is not as good for the Indiana bat; in fact, it is quite bleak. The national census of this species shows a continually downward trend. The major culprits, as in so many wildlife tragedies, are pesticides, human disturbance, and especially loss of suitable habitat.

This article is based in part on the work of Dr. Chris Burnett and Mr. James E. (Gene) Gardner. Dr. Burnett is a researcher with the Natural History Survey's Wildlife Research Section. He has been with the Survey for five years and received his Ph.D. in Ecology from Boston University. Mr. Gardner has been a researcher in the NHS' Faunistic Surveys Section since 1985. He received his M.S in Biology from Arkansas State University. For more information on bats, please write to Mr. Gardner at the NHS, or to Dr. Merlin Tuttle, Bat Conservation International, P.O. Box 162603, Austin, Texas 78716-9990

Prairie Pasture Project Underway

Prairie restoration has become very popular in Illinois in recent years. There may be unrealized potential for practical benefits from native prairie vegetation, particularly grasses, for livestock raisers, wildlife, and soil erosion control in Illinois. Through a grant provided by the Illinois Department of Energy and Natural Resources (DENR) beginning in October of this year, R.L. Westemeier, an NHS researcher, has begun a project to develop the McCormick Prairie-Chicken Sanctuary (site of the Grassland Wildlife Ecology Laboratory) as an area on which these integrated values can be researched and demonstrated.

Research in other states has demonstrated that native warm-season grasses provide cattlemen with a drought-tolerant forage on which cattle may double weight gains over that possible with conventional cool-season forages. Benefits to wildlife, particularly for nest cover, can be significant. The prairie-pasture strategy could be promoted as a viable solution to the declining number of cattle farms in Illinois. This decline has resulted in more row-cropping on erosion-prone farmland with concomitant losses of topsoil, grassland and grassland wildlife.

Tree Wounds: The Healing Process

Trees may receive wounds many times during their lifetimes. Most occur as acts of nature due to breakage by wind, ice, snow, and feeding by animals, or careless acts by man. A tree that has a deep wound probably has incurred damage to both the xylem and phloem layers. Such a wound can structurally weaken a tree, reduce translocation of sap and provide entry sites for insects or disease organisms.

Illinois data collected over five years by Dr. Dan Neely of the NHS' Section of Botany and Plant Pathology indicate that wound closure is directly related to tree vigor. Large wounds close more in one year than do small wounds. Wounds less than 12 mm. wide are likely to close in one year. Wounds of less than 12 mm. in diameter, annually inflicted, are not likely to slow tree growth. Wounds on slow-growing trees will close more per unit of radial growth than will wounds on fast-growing trees.

The Fishes of Champaign County

In 1899 a survey of the stream fishes of Champaign County was completed by Stephen A. Forbes, the founder of the NHS, and Richard E. Richardson. Every 30 years since then, the fish populations in the same stream have been resampled by other Survey scientists, revealing long-term changes in species compositions related to land-use and water quality changes.

The current project, begun in July 1987 by R.W. Larimore, L.L. Osborne and P.B. Bayley, is the fourth in this series of surveys. This survey is the most comprehensive because sites sampled thirty years ago are being quantitatively replicated using the same method so that direct estimates of changes in fish abundance are obtained. The program is funded by the U.S. Fish and Wildlife Service and the Illinois Department of Conservation.

Two Boats Dock at Surveys

The "William C. Starrett" and the "Robert E. Richardson" were launched in the waters of the Illinois River on Friday, June 12th. Named after two Illinois Natural History Survey (NHS) scientists, the two pontoon work boats will be outfitted and used as research laboratories in monitoring the Illinois and Mississippi Rivers. The two vessels are jointly owned by the Illinois Natural History Survey, the Illinois Water Survey and the Illinois Geological Survey.

The scientists on these floating laboratories will be studying stream ecology, hydrology and other subjects which will give them answers to questions of how to care for our river systems.

Plant Survival in Oil Field Brine Soils

Oil brine contaminated soils are critically eroding soils since little or no vegetation typically covers the area. Sodium-enriched soils are also extremely vulnerable to water movement. Dr. L.R. Iverson of NHS' Botany and Plant Pathology section is investigating 18 plant species for their effectiveness in providing permanent cover for these damaged areas. A test plot was established near Flora in Clay County in April 1986 to test species growth. After two growing seasons, the species showing promise for extended cover on these sites were two species of wheatgrass, switchgrass and two *Atriplex* shrubs. Erosion on the plot has been essentially eliminated, while areas surrounding the plot continue to have excessive sheet and gully erosion.

Pesticides in the Environment

Illinois agriculture suffers losses of about $500 million a year from weeds, diseases, nematodes and insects. When to use and when not to use pesticides are issues of pressing concern to the public at large and to scientists at the Illinois Natural History Survey and the staff at the Cooperative Extension Service. Both groups have been working together in an effort to manage pests on farmland, an effort that starts with the premise that good pesticide management will curtail many problems. Their strategy is called Integrated Pest Management (IPM).

IPM is based on four strategies: (1) crop pest scouting - timely field visits to identify pest density; (2) economic threshold - identifying the number of pests that can be tolerated before control is needed; (3) chemical and biological control - pesticides are not applied until the pest population has reached the economic threshold; and (4) cultural management - the use of crop rotation and resistant crop varieties to prevent pest outbreaks without using pesticides.

Eddies Are Biological Hot Spots

During the spring and fall migrations, large concentrations of diving ducks occur only in preferred locations along the Mississippi River. From the surface, these locations appear no different than other broad shallow areas, and yet, year after year, such diving ducks as the lesser scaup return to the same favored spots.

These areas support huge numbers of fingernail clams - the preferred food of the lesser scaup. Recent investigations have revealed the presence of a large eddy that causes slow circulation, keeping the water from stagnating and transporting detritus generated by nearby plant beds to the invertebrate filter feeders. The travel time of the water in the eddy is at least three times, and may be as much as 60 times, that of the adjacent water in the main channel. The formation or loss of eddies and other secondary circulation patterns may help explain yearly and longer term variations in biological production in this large river system.

Suddenly Caterpillars

The public's attention is often captured by lazy butterflies in an idyllic Illinois prairie setting or in one of the state's numerous parks. Often overlooked are the more numerous moths, not to mention their caterpillars, which may become obvious when patches of forest "suddenly" lose their leaves in late spring or mid-summer, long before frost. It is during these times that NHS scientists are most frequently called upon to help Illinois residents identify problem caterpillars.

A lack of adequate published photographs and basic descriptions of these caterpillars has made this a very difficult task. A step in resolving this informational void has been completed with the recent publication of *Immature Insects* (Kendall/Hunt Publishing Company), a book to which Drs. George Godfrey, James E. Appleby and Michael Jeffords of the NHS have made major contributions.

Information on purchasing copies of *Immature Insects* can be obtained by contacting any of the three scientists at the Illinois Natural History Survey.

Leafhopper Carrier of Horseradish Disease

Brittle root disease has caused losses of 30% to 80% of the state horseradish crop during epidemic years. Recently NHS researchers, in cooperation with the Department of Plant Pathology at the University of Illinois, evaluated the capability of the beet leafhopper as a carrier of brittle root disease in Illinois. The leafhopper readily acquires the Illinois strain of the disease and is highly efficient at transmitting it to uninfected horseradish plants. Further research is underway to to determine the incidence and spread of brittle root disease in Illinois - the leading producer of horseradish in the United States.

Midwestern Climate Center Established at Water Survey

A "missing link" in the delivery of climate information in the United States is expected to be filled by the establishment of a new institution for climate services. Regional climate centers are being established across the United States to improve the collection and dissemination of climate data and information and to coordinate and conduct applied research. The Midwestern Climate Center will be located at the Illinois Water Survey.

The Midwestern Climate Center will serve a nine-state region. There are three main components to the climate center. A data delivery system (similar to the Illinois Climate Assistance Service (CLASS) at the Water Survey, but more sophisticated and region-wide) will be developed to collect real-time weather data and provide climate information delivery to nine states. A second component of the climate center is the development of relevant historical climatic data bases. These will be a mixture of existing data bases and new data bases developed to address specific problems. The third component of the center is applied research in diverse climate issues. The research will be designed to define the key weather and climate factors that have impacts on agriculture, water resources, and the generation and consumption of energy. Research in the first years of the center will primarily deal with agriculture. Water resources and energy applications will be phased in as the center develops.

The Midwestern Climate Center will also work closely with federal agencies concerned with climate issues, such as the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture, and the U.S. Environmental Protection Agency. The center will provide assistance to federal agencies in ways similar to those provided on a regional and state basis, and will work with other federally sponsored regional climate, weather, water, and agricultural centers.

Flow Gate Operation at Dams Could Improve Water Quality

Dam flow-release gates, used to regulate water levels for navigation, can be manipulated to significantly increase dissolved oxygen concentrations in the pool below the dam. This finding resulted from a study conducted at the Starved Rock dam, located on the Illinois River below Ottawa. The dam is at the head of the 74-mile-long Peoria pool.

Thomas Butts, of the Survey's Water Quality Section, says this finding is important because it provides a way to improve dissolved oxygen levels in the Illinois Waterway without capital expenditures. Some of the natural aeration capacity that water loses when it is pooled can be partially made up as the water is passed under or over flow-release structures at a dam.

Dissolved oxygen levels have improved greatly in the last 15 years because point source waste loads have been reduced throughout the waterway. However, low dissolved oxygen levels still occur routinely along the waterway. According to Butts, no significant improvement in dissolved oxygen levels will be realized by requiring additional reductions of organic waste loads from point sources. Very little additional reduction of these loads can be achieved in a practical economic manner.

The results of the study were used to develop management schemes in which gate openings are manipulated to increase aeration efficiency without interfering with navigational needs.

Watershed Management Practices Can Significantly Reduce Erosion

Millions of tons of soil particles erode from Illinois farmlands each year. Much of this soil, carrying nutrients and fertilizers, winds up in the stream system and eventually in lakes. The soil and nutrients degrade the water quality in a number of ways. A study of the effectiveness of erosion control measures, called Best Management Practices (BMPs), installed in the Highland Silver Lake watershed found that erosion could be significantly reduced if the BMPs were applied throughout the watershed.

Water Survey hydrologist Ming T. Lee, who headed this study, says that if all the recommended BMPs were applied in the watershed, sediment yields to the lake could be reduced by about six percent, and in some areas could be cut by more than 30 percent. BMPs were installed on 11 percent of the watershed.

Highland Silver Lake, located in southwest Illinois, is used for both public water supply and recreation. Use of the lake has been impaired by high levels of turbidity and suspended sediments. The lake watershed is one of 13 experimental areas selected for participation in the Rural Clean Water Program. The program provides financial and technical assistance to landowners in installing BMPs. The goal is to reduce agricultural nonpoint pollution and bring about a resulting improvement in water quality in a 10-year testing period. The Highland Silver Lake watershed was one of five RCWP areas chosen for comprehensive monitoring and evaluation.

The Water Survey monitored the watershed for a three-year period. Computerized watershed modeling procedures were then used to predict conditions at the end of the 10-year experimental period. The results indicated that nonstructural practices, such as conservation tillage and cropland protective cover, are effective in reducing sediment yields, as well as the nitrogen and phosphorus in the sediment. Structural practices, such as terracing and grass waterways, were effective in reducing stream peak discharges at some locations.

Studies at Highland Silver Lake have concluded, but Water Survey researchers may return at the end of the 10-year experimental period to see what changes may have occurred in the watershed.

Stormwater Perils

Rainwater smells and feels so wonderful coming down. However, according to Water and Geological Survey scientists, stormwaters may contain pollutants that are endangering underground sources of drinking water. Stormwaters run off into underground injection wells, and are the subject of a Water Survey study funded by the Illinois Environmental Protection Agency (IEPA). The study concentrated on one type of underground injection well, the Class V.

"Class V wells don't handle wastes classified as 'hazardous', but the fluids they inject may still contain some harmful contaminants," says Stephen Burch, the IWS hydrologist who headed the study. "These wells have the potential to contaminate drinking water because they inject fluids into, between or above underground sources of water."

There are 1,766 Class V injection wells that are listed by the IEPA. The Survey developed a ranking system to evaluate the contamination potential of the wells. Study results ranked the most possibility of contamination to three common Illinois well types from high to low: (1) stormwater drainage wells, (2) waste disposal wells, and (3) heat pump/air condition return flow wells.

Contamination rankings were highest for stormwater drainage wells because the sand and gravel formations into which they inject fluid are frequently used as underground sources of drinking water, and also because stormwater may contain pollutants. Past studies show that urban stormwater runoff is quite likely to contain lead, copper and iron. It may also contain other pollutants, including chloride from road salt.

A Hail of a Storm

A hailstorm can be on of the most devastating types of storm, capable of moving in and out of an area in a matter of minutes. A hailstorm can do millions of dollars of damage to cars, windows, and crops in one area, while completely missing an adjacent area. Although hailstorms are fairly infrequent in Illinois, the state still ranks eighth nationally in crop damage. Hail ranks just behind drought and excessive moisture as the three most destructive weather events involving Illinois agriculture.

Hail damage to crops varies depending on the growing stage of the crop when the storm hits. In Illinois, the peak of hail activity occurs in the spring months of March to May, a small bonus for Illinois since damage can be rectified by replanting.

To obtain more information about hail, contact the Illinois Water Survey or the Crop-Hail Insurance Actuarial Association, 209 West Jackson Blvd., Suite 700, Chicago, Illinois 60606. Both services can provide data and publications relating to hail.

Ninety-six Years of Service

This year three Illinois Water Survey employees are retiring: Robert T. Sasman, in charge of the Chicago area regional office since 1956 and with the Survey since 1951; Donald H. Schnepper, a hydraulic and sanitary engineer in the Survey's Peoria laboratory since 1954; and J. Loreena Ivens, *Currents* editor, Head of the Communications Unit, and technical editor for the Survey since 1960. Among them, they have contributed 96 years of service to the Water Survey.

Bob Sasman, a prize-winning photographer, plans to continue taking and exhibiting color photos. Bob and his wife plan to travel throughout the U.S. and Europe. Don Schnepper and his wife traveled to France this past fall, and he plans to continue his activities in music in the Peoria area. Loreena Ivens is planning to stay close to her life's work by doing some free-lance writing and editing projects. She and her husband will stay in the Urbana area.

Hazardous Waste Reduction in Illinois: An Economic Perspective

by Christina Komadina and Linnea Eschenlohr

In 1985, 584 million gallons of hazardous wastes were generated in Illinois — most of it by industry. The costs of treating, storing and disposing of it are staggering — as much as a billion dollars a year.

After a century of intensive industrial development with little concern about the hazardous byproducts of our prosperity, awareness of the severity of the problem is finally becoming widespread. The challenge before us now is to do something about it.

According to David L. Thomas, Director of the Illinois Hazardous Waste Research and Information Center (HWRIC), waste reduction is a viable, long-term solution that is well within our means and, in fact, has already saved some Illinois companies millions of dollars.

"Generating hazardous waste has its costs: both to handle it and to dispose of it. And there is a potential cost due to future liability for present disposal practices. Many of the wastes we create today will have to be cleaned up in the next generation of Superfund sites," he said.

"The only safe way to break this cycle is to reduce or eliminate the generation of hazardous wastes at the source. In the process of doing this, companies improve efficiency, reduce costs for raw materials and disposal, reduce long-term liability, and achieve greater competitiveness in the market place," Thomas said.

Waste reduction, which is rapidly becoming a national priority within the federal government, has been defined by the Congressional Office of Technology Assessment as "in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste so as to reduce risks to health and the environment." The U.S. Environmental Protection Agency has a broader definition including in-plant practices plus both on-site and off-site recycling.

HWRIC has made waste reduction a high priority goal and is working on a number of fronts to encourage its adoption by Illinois generators. The Center has established a technical assistance program so generators can learn about their waste reduction options. It has also created an alternative technology data base and clearinghouse for waste reduction-related materials, and administers a matching grant program for industries to modify their existing equipment or develop new technologies to minimize the amount of hazardous waste produced.

HWRIC is encouraging waste reduction among Illinois industries by working with the Governor's office to solicit descriptions of waste reduction efforts from various companies.

"We need to find out what methods have been successful and encourage waste reduction efforts in more Illinois industries," Thomas said. "Our goals are to educate companies about the economic and environmental benefits of waste reduction and to foster communication both among industries and between industries and government," he said.

As a result of this effort, HWRIC presents the "Governor's Innovative Waste Reduction Awards" to industries, trade groups and public institutions every year. These awards are presented to recognize the waste reduction efforts made by specific hazardous waste generators. This year's awards were presented at HWRIC's "Illinois Hazardous Waste Reduction '87" conference held in Chicago on Sept. 22-23.

The economic benefits of waste reduction was one of the topics discussed at this conference. As several speakers noted, many industries don't realize that companies can often save thousands, if not millions, of dollars by implementing waste reduction techniques into their industrial processes.

In Illinois, one of the nation's largest producers of hazardous waste, waste reduction has become a high-priority item on the state's agenda.

Borg-Warner Chemicals Inc., one of this year's Governor's Award recipients, has significantly reduced hazardous waste storage and treatment costs by employing new waste reduction techniques at their Linmar Plant in Ottawa, Illinois.

Innovative management strategies, such as their plant-wide "employee involvement" program, have been at the forefront of Borg-Warner's waste reduction program. The company's "Waste Minimization Program" consists of an employee from each area of the plant who identifies all wastes in his area, investigates causes of waste generation and determines if minimization is possible.

"This spreads an attitude of waste reduction throughout the entire plant as workers discuss waste causes among themselves," Bob Miller, Borg-Warner's Environmental Manager, said.

Modifications in their industrial processes have helped the plant save disposal costs up to $196,000 and gain 2.8 million pounds of additional product per year.

Another area that Borg-Warner has focused on is the recycling and recovery of raw materials and waste plastics.

"Our recovery and recycle program has netted savings of over $70,000 per year in disposal costs and has allowed us to recycle or recover over two million pounds of industrial materials," Miller said.

Although industry is one of the state's primary hazardous waste producers, it is not the only one. Communities, households and even schools can be a source of hazardous waste.

Last summer, the Illinois Environmental Protection Agency (IEPA) collected more than 23,000 pounds of toxic and potentially dangerous surplus chemicals from Illinois high schools. The High School Laboratory Chemical Cleanup program came out of a survey of chemicals in schools that was partially funded by HWRIC. The program resulted after schools around the state asked for help in getting rid of these materials. With he threat of these chemicals removed rom the schools, IEPA officials are now sking schools to consider revising their ordering and usage procedures for these naterials.

A waste reduction technique, implenented by a professor of organic chemstry at Illinois Benedictine College IBC) in Lisle, may help other school abs better manage the amount of hazardous waste they produce. Professor David Rausch has reduced the amount of waste generated by chemistry laboraory experiments in the college by converting from macroscale to microscale distillation techniques in the organic abs. The college won the Governor's Innovative Waste Reduction Award this ear in honor of its achievement.

According to Rausch, IBC is one of he first colleges to completely convert o microscale methods.

Rausch estimates that the amount of hazardous waste produced by these experiments has been reduced from 20 kilograms a year to 100 grams a year.

"Smaller is safer," he said. "This technique eliminates Bunsen burners and provides less of a chance for fires and explosions."

Rausch and laboratory supervisor Michael O'Grady are currently acting as resource people for a "Microscale Help Line" to assist schools across the country in setting up a microscale organic laboratory.

Illinois Benedictine College and Borg-Warner Chemicals are just two examples of successful waste reduction programs in operation. Many other Illinois industries, trade groups and communities are practicing waste reduction techniques and are saving thousands of dollars in waste disposal, treatment and liability costs.

"The really exciting thing about waste reduction is that it is one of the few areas where environmental protection and industrial productivity can go hand in hand," Thomas said. "It will remain a central component of HWRIC's overall program of helping industry and others in the state better manage their waste."

Winners
1987 Governor's "Innovative Waste Reduction Awards"

Automotive Wholesalers of Illinois

The Automotive Wholesalers of Illinois has initiated an assistance program to aid its membership (mostly automotive job shops and machine shops) with environmental compliance. This is done through the publication of a short, practical compliance manual, organization of informational seminars, and publication of compliance and waste reduction tips in newsletters.

For more information contact: AWOI, Vincent Madonia, Executive Vice President, 217/786-2850.

Illinois Benedictine College, Lisle, IL

IBC is in the process of converting its educational laboratories to microscale glassware and experimental apparatus. Through this conversion, lab chemical usage is reduced by 95% or more. This will result in improved laboratory safety through reduced exposure to chemicals, improved environmental control by reduced amounts of spent chemicals requiring disposal. Significant cost savings will be achieved through reduced chemical purchases.

Contact: Prof. David J. Rausch, 312/960-1500.

Omni Circuits, Inc., Glenview, IL

Omni, a manufacturer of printed circuit boards, has implemented at their facility several process modifications that recover and reuse organic solvents and metal plating solutions. By doing this, they have greatly reduced the amount of sludges and spent solvents which must be shipped off site for disposal. Any new piece of equipment introduced into the work place is examined to determine how the amount of waste generated can be reduced.

Contact: James E. Schwartz, Jr., 312/729-7280.

Borg-Warner Chemicals, Inc., Ottawa, IL

Borg-Warner has implemented a facility-wide corporate management plan to reduce waste generation in all phases of its operation. Waste minimization teams have been established utilizing both management and line personnel to evaluate in-plant processes and practices for possible reduction of waste generation. Educational programs have been initiated to make all employees aware of the need for waste reduction. In addition to these activities, recovery systems have been initiated for both hazardous and nonhazardous materials, resulting in yearly savings of well over one million dollars.

Contact: Robert J. Miller, 815/434-7000.

MPI Label Systems of Illinois, Inc., University Park, IL

MPI has converted their label making operations from the use of organic solvent-based inks to less toxic water-based inks. This has greatly reduced their generation of hazardous wastes. They have also taken many steps to encourage their customers to use water-based inks in their operations.

Contact: Timothy G. Dawes, 312/534-5111

New Prospecting Tool for Metallic Elements

A chemical technique for determining trace amounts of metals in Illinois limestones and dolomites appears to provide another means of prospecting for mineral deposits in the subsurface of western and southern Illinois. The technique involves spectrographic analysis of metallic elements in trace amounts of residue obtained by dissolving limestone and dolomite rocks in acid. Results from a pilot study undertaken by scientists of the Illinois Geological Survey (IGS) and the U.S. Geological Survey (USGS) indicate areas of high anomalous metallic values. Distribution of the anomalous or unusually high metal values is indicative of metal transport in heated groundwater and, if mapped in more detail, are expected to outline halos around mineralized areas containing zinc, lead, fluorite and rare earth mineralization in and near the Illinois Basin. The results suggest areas requiring further exploration for subsurface minerals in western and southern Illinois.

The IGS's geological samples library provided cores and cuttings from churn and rotary-drilled wells for the pilot study. Some 4,000 composite samples were immersed in hydrochloric acid. The insoluble materials remaining were then finely ground and analyzed for 31 metallic elements. As developed by the USGS, the method previously used rock samples obtained from diamond drill core. Successful use of cuttings, small rock chips recovered during conventional oil and gas drilling, enhances the usefulness of the method.

The technique now is being used in evaluation of mineral potential in part of southern Illinois and the adjacent states of Indiana, Kentucky and Missouri in a cooperative project under the USGS Conterminous United States Mineral Assessment Program (CUSMAP) to be completed by October 1990. In a continuing effort, the IGS plans to extend the insoluble residue program to establish a statewide subsurface geochemical network for further mineral resource evaluations. Results of this pilot study, published in a document entitled "Subsurface Geochemical Investigation in Western and Southern Illinois", will be of interest to the minerals industry, resource-oriented state and local land use planners, land owners and various state and federal agencies. Released November 2, 1987, the publication is available from the IGS Information Office.

Performance Nets National Award

Robert A. Bauer, associate geologist with the Illinois Geological Survey, was honored recently by the Association of Engineering Geologists at their annual meeting as the Douglas Piteau Outstanding Young Member for "exceptional performance in his young career". Bauer, who holds an M.S. degree in engineering geology from the University of Illinois, Urbana, and a B.S. in geological science from the University of Illinois at Chicago, has been with the Survey since 1976 when hired as a research assistant. Bauer was promoted to assistant geologist in 1981 before being elevated to associate geologist in 1985.

The honoree has directed the Survey's geotechnical investigations of the proposed Superconducting Super Collider site in Illinois since 1984. From 1985 to the present, Bauer has been technical manager of the Illinois Mine Subsidence Research Program to develop guidelines for high-extraction coal mining under prime farmland. Additionally, he has been co-principal investigator of an Office of Surface Mining project to evaluate the use of Time Domain Reflectometry to monitor coal mine subsidence movements in bedrock as well as supervisor of the Survey's rock mechanics laboratory. He is the author of nine and co-author of 22 publications.

Rock Hunts Become Odyssies

Recently, geologists with the Illinois Geological Survey assisted in locating samples of Illinois stone for use in the creation of two historic monuments, one in the United States, the other in France. All 50 states have been invited to participate by contributing native rock to both projects.

A four-by-two-by-two-foot block of stone from northeastern Illinois will become part of a memorial wall in conjunction with the "Fountain of Freedom," a bicentennial tribute to the U.S. Constitution to be constructed at Independence National Historic Park in Philadelphia, Pa. Commenting on the state's stone, Dr. M. W. Leighton, Chief, IGS, said, "Most appropriately, our geologists have located a suitable block of Silurian dolomite, a type of rock that was the 'backbone' of the Chicago building stone industry in the 1800's. The rock will be 'cemented' symbolically into a monument, flanked on Independence Hall by the Liberty Bell and Independence Hall." To date, 41 states each have contributed a representative stone which will be engraved with the name of the state and the year of its admission to the Union.

The five-ton rock was donated by Vulcan Materials Company, Countryside, Ill., from its quarry at McCook, Ill. The stone was finished to specified dimensions by Tri-State Cut Stone Company of Frankfort, Ill. Finishing brought the weight of the block to 1¼ tons. Survey geologists John Masters, David Reinertsen and Donald Mikulic describe the rock as being " . . . from the Markgraf Member of the Silurian-age Joliet Dolomite, which was formed from material deposited about 420 million years ago." The rock is light gray in color, fine-grained, dense, even-textured and weathers to a very pale brown.

Coal Research Awards Assist IGS Program

Seven research projects and two support programs at the Geological Survey will receive more than $863,000 of the $2.4 million awarded to nine institutions for coal research in fiscal 1988. These contracts were authorized by the Illinois Coal Development Board and the Coal Industry Committee (CIC) through the Center for Research on Sulfur in Coal. The awards include both state funds and significant contributions from nine of the major Illinois coal mining companies.

Working on a wide spectrum of coal cleaning processes, the projects ranged from physical and chemical separation of sulfur from Illinois coal to microbiological enhancement of physical cleaning methods. In addition, funds were allocated for IGS research on the management of solid wastes derived from physical cleaning of coal, on the burning characteristics of coal containing low volatile matter, on desulfurization properties of specially treated lime, and on production of premium, high-quality, coal-derived oil. The Illinois Basin Coal Sample Bank, located at the Survey, also shared in the contracts. The bank's samples, stored under conditions that retard coal decomposition, are widely used in desulfurization research allowing a comparison of results among laboratories and processes. Allocations also covered computerization of chemical and physical information on Illinois coals.

Learn the Lay of the Land

Comfortable clothing, walking shoes, bag lunch and transportation are necessities for the IGS' forthcoming science field trips. Designed to acquaint teachers and the general public with the geology and mineral resources of Illinois, these 8:15 a.m. to 4 p.m. outings will be held April 16 in the Shawneetown area of Gallatin County and May 21 in the Canton area of Fulton County.

David L. Reinertsen, senior staff geologist, who leads the field trips, notes the ventures will begin following registration at designated locations. Participants in the April trip will register at the Shawneetown junior-senior high school, south side of State Route 13. Those attending the May outing will sign up at Canton High School, 1001 North Main Street, on the east side of State Route 78.

Open to everyone, these free expeditions provide frequent stops for exploration, discussion and collection of rocks and fossils and are especially helpful to teachers planning earth science, geography and history units. Drivers should begin the tour with a full tank of gas. For more information, contact the Illinois Geological Survey, 217/333-4747.

Richard C. Hartnack

Richard A. Lumpkin

Society Elects New Board Members

Richard C. Hartnack is Senior Vice President and head of the Personal Banking Group for First Chicago Corporation. His responsibilities include all personal and small business financial services (except for credit cards) at First National Bank of Chicago and at suburban First Chicago Bank locations.

He joined First Chicago in June, 1982 and was promoted to his current position in July 1987. Prior to joining the bank, he was Senior Vice President at First Interstate Bank of Oregon where he headed the Corporate Banking Division of that $5 billion regional bank.

Mr. Hartnack, a native Californian, received his B.A. degree in economics from U.C.L.A. in 1967 and an M.B.A. from Stanford in 1976. He served as a Captain in the U.S. Marine Corps during the Vietnam War and flew 220 combat missions in the F-4 Phantom Jet.

He is a Director of the Child Care Society, Stanford Business School Alumni Association and Public Interest Law Institute. He is Treasurer of the Child Welfare League and Chairman of the Community Investment Corporation

He lives in Winnetka with his wife, Dail, and three children.

Richard A. Lumpkin is president of Consolidated Communications, Inc., a diversified telecommunications company headquartered in Mattoon. The company was originally organized by his great grandfather in 1894. Today, its principal subsidiary, Illinois Consolidated Telephone Company, provides local exchange service to 37 communities in the central part of the state.

As in many family businesses, Lumpkin has worked in almost every aspect of the business. He has also served as president of the Illinois Telephone Association and the United States Telephone Association. He is a past Director of the Illinois State Chamber of Commerce.

Mr. Lumpkin contributes a significant portion of his time to community organizations. He is trustee of Millikin University, a director of Sarah Bush Lincoln Health Systems, Inc., East Central Illinois Development Corporation, and Eastern Illinois University Foundation. He graduated from Yale University in 1957 and The Harvard Business School in 1963.

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THE NATURE OF ILLINOIS

Spring/Summer, 1988

Published by the Society for the Illinois Scientific Surveys

The Society Page

With spring here and summer on the horizon, many of the scientists at the Illinois Natural History, Geological and Water Surveys are in the field. They are working to preserve and protect the nature of Illinois. In these pages we try to bring you a little of their world, as they move from the problems of shoreline erosion in Chicago to oil production research in southern Illinois.

You might not recognize it, but that's Illinois on the cover. The southernmost sixteen counties of Illinois contain some of the most beautiful natural areas I have seen anywhere — fern forests, cypress trees, caves, cliffs, swamps. **Southern Illinois** offers us an exhilarating variety of natural features to choose from, even though many of our state's residents are barely aware of them. The Natural History Survey's scientists take author Jim Krohe, and the rest of us, on an armchair tour of forgotten Illinois.

Most of us enjoy a good fish story, and **the domestic saga of the bluegill** is certainly unique. Natural History Survey researchers, along with scientists at the University of Toronto and the University of Illinois, provide us a rare glimpse of a species with two different males and two different mating strategies.

A side benefit of the siting work done for the superconducting super collider is vast amounts of Illinois archaeological data. I remember how excited we all were by the work done at the Koster archaeological site in the lower Illinois River Valley. **Radiocarbon age dating** studies performed by the Illinois Geological Survey helped identify twelve cultures dating as far back as 8,000 to 10,000 B.C. The radiocarbon dating laboratory at the Survey is only one of forty throughout the country and is an invaluable asset to our archaeologists and geologists.

While working to conserve our history and our natural resources, Survey scientists also strive to promote our state's economic growth. No civilization progresses far without adequate water supplies. **Protection of Illinois' groundwater resources** is the focus of a multi-agency effort spurred on by the 1987 passage of the Illinois Groundwater Protection Act. It is also the focus of a special article in this issue. We particularly hope that you enjoy and clip out the special insert on the water cycle.

NIMBY is the acronym for **Not In My Back Yard**, and it is a social phenomenon that is affecting the placement of facilities as diverse as state parks and low-level radioactive waste facilities. As a follow-up to the nuclear waste article in our last issue, we offer you a think-piece on NIMBY-ism from journalist Don Sevener.

On a more musical note, Natural History researcher Dr. Scott Robinson is taking a hard look at what is happening to Illinois' songbirds as a result of greater **forest fragmentation.**

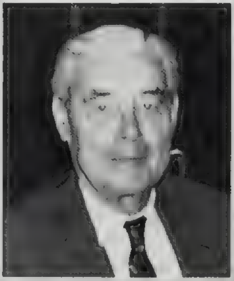
Please join us in supporting the efforts of these dedicated and hardworking professionals by becoming a member of our Society. Help us promote wise stewardship of the nature of Illinois.

Enjoy a happy and natural spring!

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors



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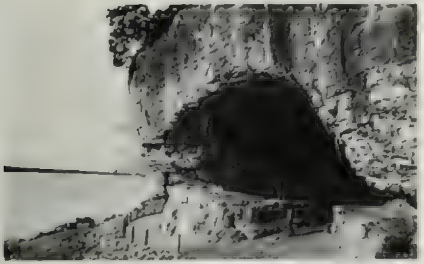
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Heron Pond, Johnson County. Photo Credit: Illinois Water Survey.

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Editorial Staff

Jane A. Bolin
Editor

Eric Holgerson
Assistant to the Editor

ComUnigraph
Design and Production

The Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 1525 South 6th Street, Suite B, Springfield, Il 62703

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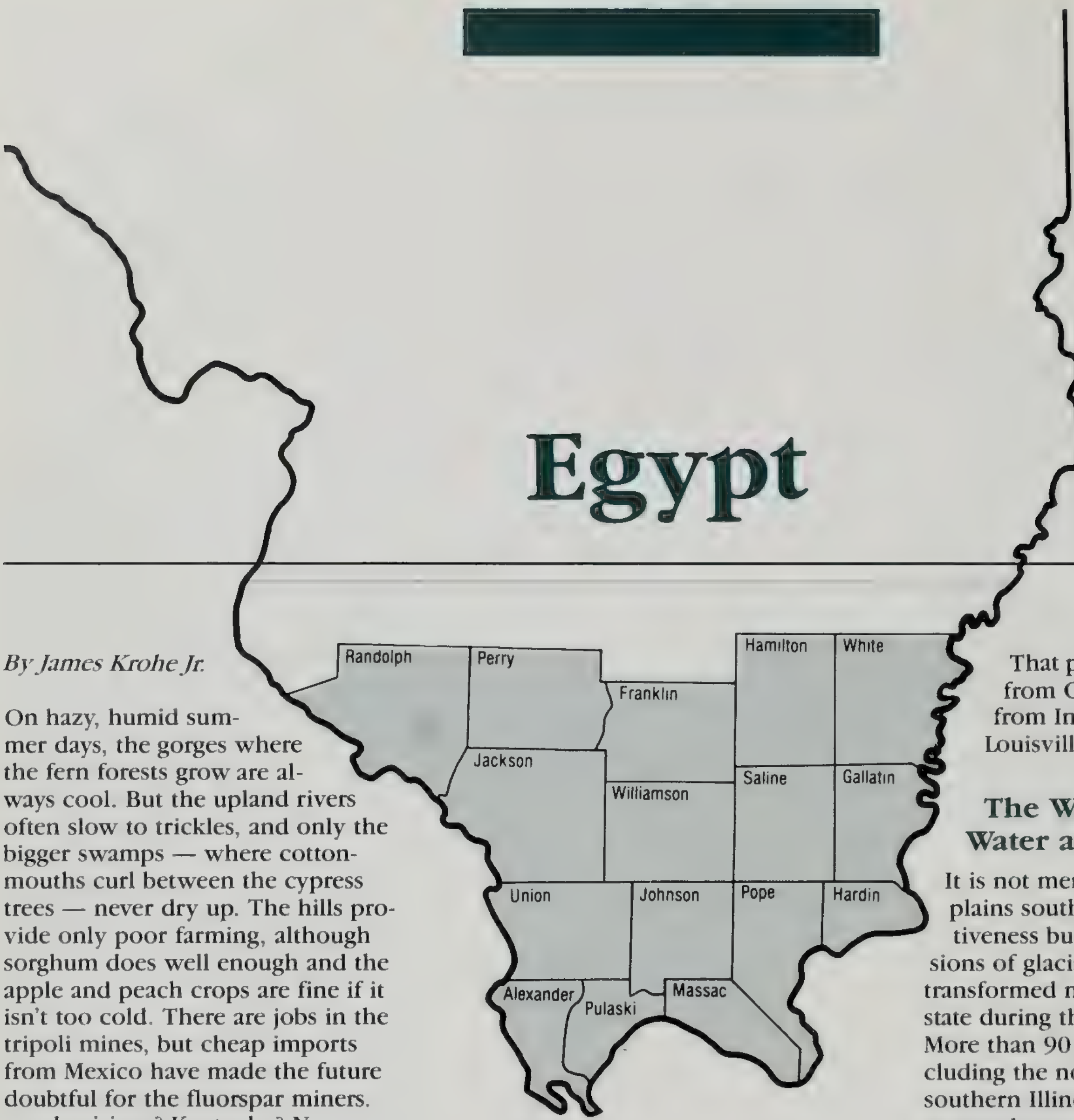
Egypt

By James Krohe Jr.



On hazy, humid summer days, the gorges where the fern forests grow are always cool. But the upland rivers often slow to trickles, and only the bigger swamps — where cottonmouths curl between the cypress trees — never dry up. The hills provide only poor farming, although sorghum does well enough and the apple and peach crops are fine if it isn't too cold. There are jobs in the tripoli mines, but cheap imports from Mexico have made the future doubtful for the fluorspar miners.

Louisiana? Kentucky? No, Illinois. The southernmost 16 counties of the Prairie State comprise the warmest, lowest, hilliest, tree-iest part of Illinois. Nestled in the arms of the Mississippi, Wabash, and Ohio rivers, the region is Illinois in a cartographic image. But geologically, climatologically, and ecologically it is closer kin to the border-state South.

To its historically minded residents, southern Illinois is still "Egypt," the nickname attached to it in the 1840's in honor of its fabled (and ultimately short-lived) fertility. To the rest of the state, southern Illinois is no particular place at all. One of the standard guide books to Illinois — the one authored by the old Works Progress Administration, published in 1939 and revised in 1974 — profiles only one southern town of the 22 Illinois towns and cities which get special mention. Even that one — Cairo — interests the authors more for what it was than what it is.

Part of the problem is that southern Illinois is physically remote from the economic and political centers of Illinois. Geography is destiny, and Carbondale, the region's largest city, is 331 miles from Chicago. That puts Carbondale farther from Chicago than Chicago is from Indianapolis, Dubuque, Louisville, Cincinnati, or Detroit.

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The southernmost 16 counties of the Prairie State comprise the warmest, lowest, hilliest, tree-iest part of Illinois.

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The War of Water and Stone

It is not mere distance which explains southern Illinois' distinctiveness but nature. Repeated invasions of glacial ice physically transformed most of the rest of the state during the Pleistocene Age. More than 90 percent of Illinois (including the northern edge of southern Illinois) lies in what geographers call the Central Lowland of the United States, a physiographic region which is about as interesting as its name suggests. By comparison, the unglaciated south of the state is a riot of topography. The Shawnee Hills (the northernmost extension of the Ozark Mountains) are part of the Interior Low Plateau which peeks into Illinois from the east. The Ozark Plateau reaches into southern Illinois from the west, and the Coastal Plain — coastal as in "Gulf coast," a bit of the bayou country gone upriver — forms the extreme southern tip of the state.

Glacial ice repeatedly interrupted erosional processes in the north, obliterating old landscapes and depositing new ones, most recently about 12,000 years ago. In contrast, the south's hillsides tend to be steeper, valleys deeper than elsewhere in Illinois. As Richard Berg, an environmental geologist with the Illinois Geological Survey explains, "Mother Nature has had a long time to operate on it and carve it out. The land is much more dissected and the streams are more entrenched." The thin mantle of surface deposits has been washed or blown away to reveal bedrock in many places; once exposed, that rock has been carved into steep canyons, even natural stone bridges.

Time and physiographic variety combined to produce a local landscape of exhilarating diversity. There are clay plains, sandstone ravines, muddy floodplains, gravel hills, cliffs, caves, and swamps — each feature a treaty of sorts in the wars which have been fought for tens of thousands of years between water and stone.

If geology supplied the canvas on which southern Illinois' face was drawn, climate provided the brush. Harrisburg lies farther south than does Louisville, Kentucky. Mean annual snowfall on southern Illinois is only nine inches, compared to the 33 inches which usually fall every winter on northern Illinois. Season by season, the southern counties are 16 degrees fahrenheit warmer than their upstate cousins. They are also wetter, a fact owed partly to terrain. As Wayne Wendland of the Illinois Water Survey explains, the hills in southern Illinois push moist air masses upward as they pass, cooling them and making local precipitation rates roughly 10 percent higher than they would be otherwise.

Natural Divisions

Together, geology and climate define not just the landscape but the possibilities for life in any region. Diverse habitat explains why five of the 14 "natural divisions" identified in Illinois are represented in southern Illinois even though the region encompasses only 11 percent of the state's land area. The plant and animal life which has come to occupy these niches is as different from that of the rest of the state as the terrain. The Shawnee National Forest sprawls across parts of 10 of the 16 southern Illinois counties. A recent study found that the forest was home to more than 500 wildlife species, many of them rare. Many creatures are found in Illinois only in these counties. A few, such as the crayfish *Orconectes illinoiensis*, are found only in these counties period, being known nowhere else.

In the 1970s, Illinois Natural History Survey botanist Robert Evers (now retired) and fish taxonomist Larry Page described a few of the region's riches in Biological Notes No. 100, "Some Unusual Natural Areas in Illinois." They described insects which stroll about in the snow and grasshoppers which look like lichens, grass that grows eight feet tall and plant communities which dwell on floating logs, cavefish and rice rats and bird-voiced tree frogs and beetles bigger than some mammals, and mosquito fern so thick that it makes open water look like a manicured lawn.

Dept. of Conservation

Cave in Rock State Park, Hardin County

Because southern Illinois sits on the continental cusp between north and south, east and west, its flora and fauna comprise quite cosmopolitan communities. At Jackson Hollow, filmy ferns grow in the shady, moist undercuts of cliffs on whose sun-baked crowns rock selaginella grows on solid sandstone. The local staphylinid beetle is a truant from its original eastern habitat, as are relict populations of northern fishes who have found refuge in the cool spring-fed waters of Hardin County's Big Creek. Visit LaRue swamp in Union County, however, and (in the words of Evers and Page), "The plaintive calls of the chuck-will's-widow and the mockingbird remind one that he is now in the southland."

Why the ranges of certain plants and animals are limited to these counties is not well understood. Some explanations are obvious. As Page puts it, a swamp creature will usually be found where the swamps are. But Glen Sanderson of the Natural History Survey notes that even though habitat suitable for southern Illinois' swamp rabbit, for example, exists in the form of stream bottoms in other parts of the state, the animal has never strayed far from its present home. "We just can't put our finger on it, although it's probably the climate," Sanderson suggests, speculating that differences in the species' enzyme system may leave it less adaptable to cold.

Southern Illinois was the most heavily forested part of presettlement Illinois. The oak-hickory forest common to the rest of the state occurs here, but so does beech-maple forest from the east and such southern species as cypress, pecan, tupelo, and catalpa. Most of the present stands are second-growth timber at best and thus pale shadows of their 19th century ancestors, but a few majestic patches of presettlement forests survive. "Certainly there are places which have never been timbered," confirms Louis Iverson, Natural History Survey botanist Cypresses have reached 100 feet, and some sycamores in the Wabash River bottomland stand 175 feet tall

Extracting the Past

To drive through southern Illinois is to take a tour of Illinois' past Southern Illinois today probabl looks much the way the rest Ill

Illinois looked before it was buried under the thick blankets of sands, silts, and gravels left behind by the glaciers. The major plant communities in turn constitute a museum of climatological change. Remnants of the northern boreal forests which covered Illinois during cooler eras survive in the shade of cliffs. Prairie openings on blufftops are reminders of warmer, dryer intervals, while relicts of more recent moist forest types still grow in ravine bottoms.

Here and there, the traveler can glimpse an even more ancient past. The bedrock of the Illinois Basin is cupped, the strata of succeeding geologic ages stacked like spoons. Buried under hundreds of feet of glacial debris elsewhere, the edges of these strata emerge at or near the surface in western and southern Illinois. The exposed rock is Pennsylvania-era sandstones and limestones mostly, along with older Mississippian, Silurian, and Ordovician formations.

In these fossil landscapes are hidden minerals which are no less exotic in their origins than the modern plants and animals which dwell atop them. Tripoli, or amorphous silica, is a very fine-grained quartz used to polish glass, among other industrial uses. The only known deposits of it occur in Union and Alexander counties, where it has been mined since early in this century. "Those rocks in other parts of the state tend to contain lots of cherty materials," explains John Masters of the Geological Survey. "For some reason that material has been altered in that local area, perhaps as a result of a very ancient period of weathering."

Fluorspar is another unique mineral extensively used in the manufacture of steel, aluminum, and chemicals. Only Mexico and China have larger deposits than the United States, and most U.S. output comes from Hardin and Pope counties. The deposits were created when fluorine-rich solutions seeped into limestone from deep in the earth, dissolving the host stone and replacing it with fluorite. "The process is fairly common," says Masters, "but the occurrence of deposits of mineable quantity is not."

Mineral extraction was southern Illinois' first industry, and remains its largest. In the mid-19th century, salt was evaporated from brackish spring water along the Saline River for export up and down the Ohio River.

Garden of the Gods, Shawnee National Forest

Dept. of Commerce and Community Affairs

Today the river barges carry coal, not salt. There is coal under most of Illinois, but in few other spots are the deposits so thick at mineable depths. Springfield and Herrin coals occur here within reach of giant strip mine shovels, in veins as thick as 8-15 feet. At greater depths lie most of the few sizeable deposits of relatively low-sulfur coal in Illinois. As a result, coal is mined in nine of the 16 southernmost counties. Combined, their mines account for nearly two-thirds of the state's total output in recent years.

Our Southern Brethren

Such natural wealth, along with its network of river highways, explains why southern Illinois has a record of continuous human habitation stretching back at least 15,000 years. Archaeological surveys of the Shawnee National Forest grounds alone have so far found more than 900 prehistoric sites. The Indians, such as those who repeatedly camped at the rock shelter at Modoc between 4,000 and 10,000 years ago, found plentiful game, nuts, and fish. The French, whose 18th century occupation of the region is revealed in the names of Prairie du Rocher and Fort de Chartres and the architecture of Kaskaskia and Cahokia, grew rich trading in grains and furs.

The French were only the first phase of European settlement in the region. In the 19th century, white settlement began in earnest. Most of the newcomers came across the Ohio from Kentucky and the mid-Atlantic states to the east in the years before the Erie Canal and then the railroads opened up the flatter, more fertile parts of the state. Local culture historically reflects the traits of hill people everywhere, including independence, clannishness, and skepticism of outsiders. (For example, poaching on public land is considered less a crime than a tradition.) Even today, many southern Illinoisans speak with more of a drawl than a twang. It should not surprise the visitor that some southern Illinoisans are more southern than Illinoisan. Marion, after all, lies 150 miles south of the old Mason-Dixon Line.

The French came as artisans,

missionaries, and traders and they prospered. Later arrivals were largely poor and unskilled, and thus were doomed, at least at first, to subsistence farming. Making a living in southern Illinois has never been easy. For as long as there has been a rest of the state, the southern part of Illinois has lagged behind it in income and employment. Farms in southern Illinois have been smaller than elsewhere in Illinois, and earn less. Sorghum and wheat are more drought-tolerant than corn and soybeans but they do not earn as much. The hills and heavy clay soils leave much of the region ill-suited to Illinois' more familiar farm staples. Instead, fruit orchards profitably combine agriculture and forestry in some areas. Union and Saline counties lead Illinois in the production of such horticultural exotica as cucumbers, sweet peppers, and popcorn.

A Fragile Delta

As the region became more heavily populated, the fertility of this new Egypt quickly proved to be fragile. Overhunting decimated the birds and large game which had astonished travelers such as the young Audubon. Huge tracts of timber were cleared for farming, building, and fuel. (At the height of the salt industry, for instance, the state legislature set aside 180,000 acres of timber just to keep the salt-maker's kettles boiling.) Unfortunately soil which can sustain a forest often cannot sustain a farm. The soils of southern Illinois were only a few inches thick in places. Exposed to weather for 60,000 years (far longer than the newer soil of the north), they were often acid and nutrient-poor as a result of leaching. Erosion quickly chewed away the hillsides once the protective cover of trees was removed. The clay pan which lies just beneath the surface across much of the region keeps rain and melting snow from soaking into deeper soil layers. Surface water runs off quickly, leaving many areas prone to flooding when it rains too much and prone to drought when it doesn't rain enough.

As a result, the attempt to wrestle a living from land not well suited for it damaged both the farms and the farmers. By the 1930's the region was littered with thousands of acres of fields which had been abandoned because either the soil or the farmer was too poor. ("You can't grow corn on bedrock," observes Berg.) Timberland had been overcut in places and pasture overgrazed. The federal government bought up nearly 90,000 acres of spent land, the nucleus of what is today the more than quarter-million-acre Shawnee National Forest.

As forests go, the Shawnee is an oddity, and its oddness tells a lot about the often careless human occupation of southern Illinois. To save the soil federal agencies planted some 46,000 acres in pine populations, which some ecologists today regard as weeds in the garden compared to the native deciduous woods they replaced. The wooded tracts are not continuous in any event, being interspersed with towns, farms, and mines.

The wholesale despoliation of land inside the forest boundaries has ceased, of course, but elsewhere the region's natural resources are still often misused. Forested private land is still being cleared to plant highly erodible row crops. Manmade fires are fairly common, and unrestricted grazing of woods by livestock has killed off native understory plant species and left woods open to invasion by non-native weeds.

And the future? The history of the region may be summarized by three facts: Southern Illinois was the site of Illinois' first bank (Shawneetown), its first capital (Kaskaskia), and its first state park (Ft. Massac, which opened in 1903). How long the coal will last can't be predicted, and agriculture may never be dependably profitable. But southern Illinois' terrain and wildlife are proving to be a profitable base for expanding tourism and recreation industries. Cairo may or may not be the "Goose Capital of the World," as it has claimed, but it certainly is the goose capital of Illinois. Hundreds of thousands of waterfowl such as Canada geese make their homes in the region's many wildlife refuges. Hunting and fishing (indeed living in a setting of such striking beauty) are making it a refuge for humans too specifically the ex-urbanites who began flocking to the region to live in the 1970's. Not for the first time, the past of southern Illinois may well be its future

Dept. of Conservation

Fern Clyffe State Park, Johnson County

Sex And The Single Bluegill

Birds do it. Bees do it. Even educated fleas do it. Bluegill do it too, but very differently.

Among the most common of North American freshwater fish, the bluegill *(Lepomis macrochirus)* is one of the most fished for species in Illinois. It is also the official state fish, beating out the carp and other species for that honor in an election by the state's schoolchildren. The bluegill belongs to the sunfish family, *Centrarchidae*, which also includes the basses and crappies. The bluegill is found throughout much of this country south from Ontario through Florida and from the east coast westward across the Mississippi drainage. The average size of an adult male bluegill is one-quarter pound and seven to eight inches long, although some may exceed one-half pound. Females are smaller, with an average length of four to six inches.

What is uncommon about the bluegill is its complex reproductive behavior. Bluegill males follow two alternative mating strategies: cuckoldry or parental care. Researchers from the Illinois Natural History Survey (NHS), working with scientists at the University of Toronto and the University of Illinois, are conducting field and laboratory experiments at the NHS and at the Queen's University Biological Station on Lake Opinicon, Ontario, to explain these complex behaviors.

Spawning Bouts

The domestic drama of the bluegill unfolds in this way. In late spring to mid-summer, mature adult males move into shallow areas and form breeding colonies. Anywhere from 10 to 200 males congregate and build adjacent nests. Nests are shallow, bowl-shaped depressions built by parental males using lateral sweeping movements with their tail fins. These males are extremely territorial and aggressive towards intruders at these sites.

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What is uncommon about the bluegill is its complex reproductive behavior. Bluegill males follow two alternative mating strategies: cuckoldry or parental care.

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Once the colony is established and nest construction is completed, female bluegill (in schools of up to a thousand individuals) move into the area to spawn. Since a single female will spawn with a variety of males, a nest will have batches of eggs from different females. Spawning can last from only a few hours to more than a day.

Actual spawning behavior consists of a female entering the nest of a male, who then begins to circle around her until she dips on her side to release 10 to 20 eggs. As she releases the eggs, the male fertilizes them. After the spawning bout is completed, the females leave the males to remain in the nest and assume all parental care for the newly-laid eggs.

Sneakers and Mimics

Dr. Mart Gross, a zoologist at the University of Toronto, began studying bluegill reproduction at Lake Opinicon in the mid-1970's. He found that the typical male bluegill, called a "parental" male, took seven years to sexually mature, participating in colonial spawning from age seven to age ten or eleven.

He also discovered that certain male bluegills did not exhibit the typical pattern of mating, but instead matured sexually at age two or three, when they were only two to three inches long. During spawning, these sexually precocious males move among the lake's weeds and hide in positions near nests containing spawning pairs. At the right moment they quickly dart under the pair, releasing sperm in an attempt to steal fertilizations from the parental male. During this action, these males are successful in fertilizing a portion of the eggs, thus earning the term "sneaker" males.

Precocious males are most effective at sneaking when small and less detectable. At the age of four, these cuckolders become too large to sneak into the nests and acquire a new behavioral tactic — female mimicry. Females in Lake Opinicon reach sexual maturity at age five or six. These adult females are smaller and lighter in color than adult parental males, but about the same size as the four year old cuckolder. These cuckolders, termed satellite males, mimic the color and behavior of the females, fooling the parental male into allowing them into the nest and then positioning themselves between the parental male and the true female.

The parental male believes he is spawning with two females, and the mimic therefore escapes the aggression of the parental male. In fact the mimic is adjacent to the female and probably has the better spawning position. Precocious male bluegill spawn as female mimics through age five but then die a full two years before their brother parentals reach sexual maturity. Sneakers and mimics do not grow up to become parental males. The two alternative reproductive strategies — parental behavior and cuckoldry — are mutually exclusive.

Maximizing Fitness

Dr. David Philipp and Julie Claussen of the NHS, and Dr. Janice Bahr and Pawel Kindler of the Department of Animal Sciences at the University of Illinois, are collaborating with Dr. Gross in an effort to understand the hows and whys of these alternative mating strategies.

Their research to date disproves the original idea that sneakers and mimics were just rare, abnormal individuals who were sick or were eating eggs. Instead their research predicts that these mating strategies and behaviors are a mixture of evolutionary stable strategies (ESS's). This mixture of parental, sneaker and satellite males is stable evolutionarily over time and will not disappear. For these ESS's to exist, however, the theory predicts that the fitness of males entering the cuckolder and the parental pathways must be equal.

Dr. David Philipp INHS

A bluegill parental male spawning with female.

Dr. Mart Gross

Parental male and female spawning. The satellite male is in the middle, mimicking the true female.

According to Dr. David Philipp, "These mixed mating strategies are genetically based and have evolved from mutation. It goes back to the male-male competition for central over peripheral nest sites, the sites preferred by females while spawning. To get that favored central nest site, males need to be larger than their competitors. To become larger, males have to delay maturation. Of course that delay in maturation is accompanied by an increase in mortality costs for the parental males."

"A mutation occurred somewhere along the line, allowing early sexual maturation for some males. These males, the sneakers and the satellites, could not compete for central nest position, but they could in effect steal fertilizations from the larger parentals. These two strategies are stable because each one has equal fitness for its participants. In Lake Opinicon 75 percent of one-year old males evolutionarily "choose" to become cuckolders."

"However, many more of the parental males die in waiting until age seven to mature sexually than do sneaker males who only need wait until age two to mature. The trade-off between mortality and fertilization success is the basis for the predicted equality of fitness for the two strategies. We have shown that these reproductive behaviors are inherited, and now we are trying to quantify the fitness of males in the two strategies to prove this new theory."

The research team is also looking at the biochemical mechanisms regulating these mating strategies. The researchers postulate that there is some endocrine trigger that causes the sneaker's gonads to mature early, resulting in his unique set of sexual behaviors. Early experiments indicate that the fish androgens testosterone and 11 ketotestosterone (11KT) affect both parental and cuckolder males in different ways. Parental males experience a spike of 11KT that drives male-male aggression before spawning.

Experimental time release hormonal implants in bluegill males have affected their behavior. A current experiment is designed to show that, in the absence of parental males, satellite males given elevated amounts of 11 KT build nests and act as parentals. Multidisciplinary experiments of this type will tie together the facts needed to answer key questions concerned with the evolution of sexual behavior.

This article is based on the work of Dr. Mart Gross, an Associate Professor in the Department of Zoology at the University of Toronto; Dr. David Philipp, a Fisheries Geneticist with the NHS; Julie Claussen, an NHS Research Biologist; Pawell Kindler, a graduate student at the University of Illinois; and Dr. Janice Bahr, a Professor in the Department of Animal Sciences at the University of Illinois at Urbana

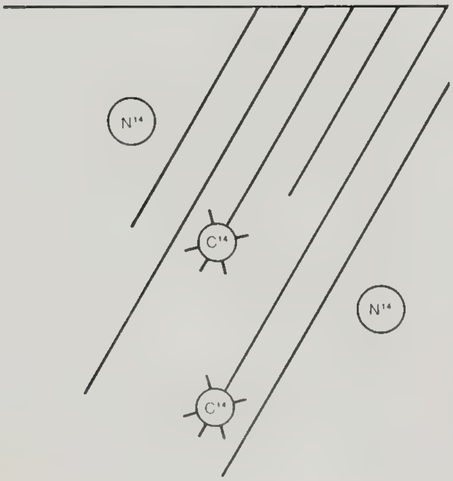
Dating Illinois

In 1950 Willard Libby revolutionized archaeology, geology and many other sciences with the radiocarbon method of age dating. Developed at the University of Chicago, Libby's method is being used today by the Illinois Geological Survey (IGS) for projects ranging from tracing glacial and postglacial levels of Lake Michigan to assisting archaeologists with the history of prehistoric cultures in Illinois.

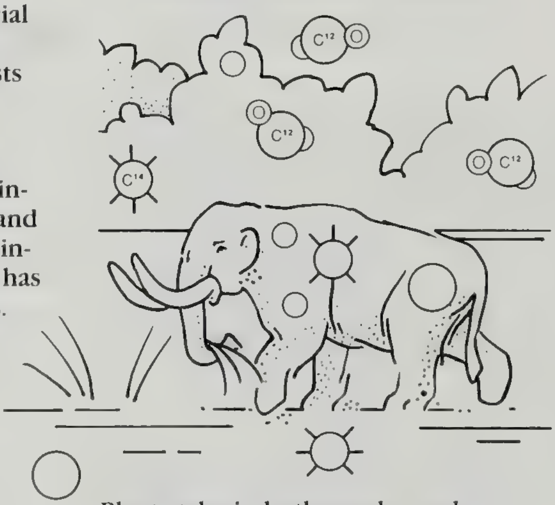
The radiocarbon age dating technique takes advantage of the interplay between our atmosphere and all carbon-containing substances, including living organisms. Carbon has three naturally-occurring isotopes. Two of these, carbon-12 and carbon-13, are stable. The third, carbon-14 or radiocarbon, emits small amounts of radioactivity.

From the Field

Cosmic rays, which are constantly entering the atmosphere, change some of the nitrogen-14 atoms in the air into radiocarbon. These carbon-14 atoms are formed at nearly the same rate all the time.

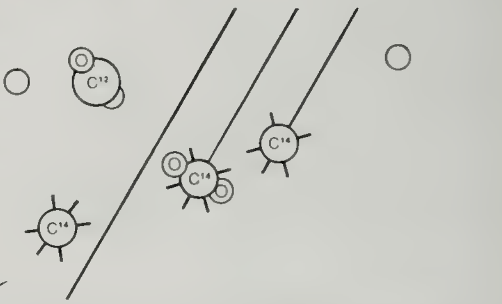


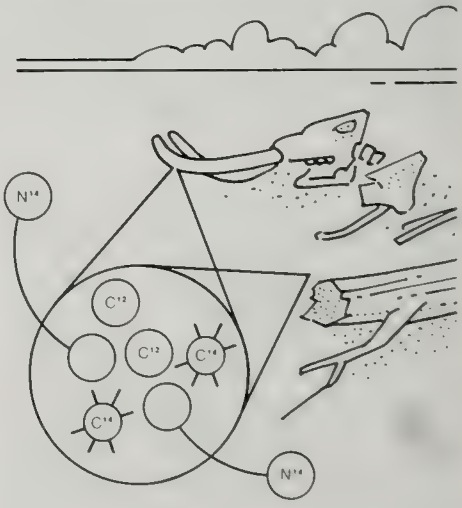
Oxygen atoms combine with radiocarbon atoms in the atmosphere to form radioactive carbon dioxide. Almost all of the carbon dioxide in the air is made with non-radioactive carbon-12 and carbon-13, but about .0000000001 percent is carbon-14.



Plants take in both regular and radioactive carbon dioxide and grow tissues with it. Animals eating these plants also take radiocarbon into their tissues. There is a balance between the rate of radiocarbon production and radioactive decay. All living organisms in equilibrium with the atmosphere maintain small natural concentrations of radiocarbon in their bodies that are nearly the same as the proportion of radiocarbon in the air.

After plants and animals die, they no longer take in radiocarbon and regular carbon. Radiocarbon atoms in the dead tissue begin to decay to nitrogen-14 atoms at a steady rate. The rate of decay is expressed by the half-life of radiocarbon, the time taken for half of the carbon-14 atoms in any sample to decay. The half-life of radiocarbon is 5730 years. The time since the plant or animal died can be determined by measuring the amount of radiocarbon remaining in the tissues. After a plant or animal has been dead for about 50,000 years, the amount of radiocarbon remaining is so small that it can no longer be measured with normal equipment. When a sample is analyzed in the laboratory, its age is stated as *x* years Before Present (BP). The present is taken as the year 1950, so that the reported age is not dependent on when the analysis was made.





Dennis Coleman (left) and chemist Barry Fisher examine a 10,000-year-old mastodon tooth recovered from a site near Urbana. The laboratory systems in the background are used for the conversion of carbon dioxide to benzene.

To The Laboratory

Once a sample is delivered to a laboratory, several techniques are available for radiocarbon age dating. Scientists at the Geological Survey's Isotope Geochemistry Laboratory use the benzene liquid scintillation technique to date the nearly 200 samples they receive each year.

Samples are rarely delivered in pristine condition, so that the first order of business is to clean out any contaminants that might not be an original component of the sample. Without this cleaning technique, dates could be compromised. The most common field contaminants are plant rootlets, humic acids and carbonates. Humic acid is a generic term describing the organic breakdown products of plants and animals. They are mobile in the soil and can accumulate in porous sections of a sample. Carbonates are present in most natural waters and environments and can contaminate some sample materials.

The first step in the laboratory is cleaning the sample. This is done by boiling the sample in acid to rid it of carbonates. The original carbon in the sample is not soluble. The sample is then washed with sodium hydroxide to eliminate humic acids.

In a closed system, under pure oxygen, the now-clean sample is burned, and all carbon in the sample is converted to carbon dioxide, a gas. A series of chemical conversions are then made to change the carbon dioxide to benzene.

The benezene is placed into a liquid scintillation counter, which measures how much radioactive carbon is left in the sample. As the carbon-14 atoms disintegrate, they give off light flashes. These are measured electronically in the counter by two photomultiplier tubes. Within 24 hours, the counter can tell researchers how many light flashes have taken place. This number is then compared with a sample containing a known amount of carbon-14 and with a sample having no carbon-14. Mathematic calculations complete, the IGS scientists can tell how old the sample is.

And Back To The Field

According to Dr. Dennis Coleman, Head of the Geochemistry Section, the Radiocarbon Dating Laboratory was originally established as an aid to the Survey's geologists for the dating of glacial materials. Now the laboratory, the only one of its kind in Illinois and one of only about 40 in the country, dates samples for many diverse projects.

"We have strict guidelines for accepting samples: the project is being conducted at an Illinois institution or by an Illinois researcher, or the project has some general relevance for Illinois whether done by college researchers in or out of state. We also want assurances that the samples have been properly collected and documented and that they are scientifically significant and not just a matter of curiosity. Sixty percent of our samples come from archaeologists; the other 40 percent are from geologists."

"For geologists, we frequently correlate the age of sediments in one area against the age of those in another. Our support has been especially helpful in two recent projects involving the timing and causes of high lake phases in the Lake Michigan basin. We do a lot of work with archaeologists as well. We're assisting a professor now at the University of Illinois to establish a chronology of Upper Paleolithic settlements in eastern Europe. And we're dating some dwarf hippopotamus bones from southern Cyprus for the Field Museum in Chicago."

Radiocarbon is also being used in studying a possible coal desulfurization technique. One of the coal studies at the IGS involves the use of carbon monoxide and ethanol (corn alcohol) to rid coal of sulfur. Radiocarbon is used as a tracer to detect whether the alcohol is used up during the process by being retained in the coal. Coal has no radiocarbon because it is millions of years old, but the alcohol is from modern corn and thus contains radiocarbon. A radiocarbon analysis performed on the treated coal will tell how much alcohol is being retained in the coal and thus is being used by the process. The amount of alcohol retained in the coal as shown by the radiocarbon analysis greatly affects the economics of the process.

"One of the laboratory's biggest success stories was the radiocarbon dating done for the Koster archaeological site in the lower Illinois River valley, a natural spot for habitation by early man," relates Coleman "Radiocarbon tests conducted by the IGS helped archaeologists map at least 12 cultures (horizons), dating as far back as 8,000 to 10,000 B.C."

"I suppose one of our stranger projects involved dating leopard droppings from Egypt. After 5,000 years they smell just as bad now as they did back then."

Dr. Dennis Coleman received his PhD in Geochemistry at the University of Illinois, and is Head of the Geochemistry Section at the Illinois Geological Survey

“Whose Backyard Is It Anyway?”

by Donald Sevener

The battle cry has become almost tiresomely familiar. In recent months outraged citizens have organized to oppose a new prison in Decatur, the superconducting super collider near Batavia, and a low-level radioactive waste facility almost everywhere. Blanca Souder of Kaneville summed up the sentiments of many when she invoked the battle cry at a U.S. Department of Energy hearing earlier this year. “I’m not against the collider,” Souder said, “but I don’t want it in my back yard.”

This is NIMBYism — the “Not In My Backyard” syndrome that has become so widespread that it has earned its own acronym. Although the phenomenon is usually manifest in complaints about declining property values or the hazards of chemical or radioactive wastes, many experts believe the roots of NIMBYism grow much deeper. “I know people who oppose the establishment of a state park or children’s playground near their home,” says Tom Kerr, chief of the low-level radioactive waste division of the Illinois Department of Nuclear Safety. “Their lives are comfortable and they don’t want their lives to change.”

This resistance to change leaves developers, scientists, and governmental agencies wondering how to overcome opposition they generally believe is irrational to build projects they consider safe. The gap separating those who want to build a controversial facility and those who are asked to live next to it generally is the result of a difference in what is called “risk perception.”

Defining Risk

“The core problem is definition,” says Peter M. Sandman, a professor of environmental journalism at Rutgers University. “To the experts, risk means expected annual mortality. But to the public (and even to the experts when they go home at night), risk means much more than that.”

Sandman suggests there are two dimensions to risk. The first he calls “Hazard. It is the technical dimension: how dangerous is it? Will it damage my health, my property, or the image of my community? This is a straightforward, intellectual issue.”

“Risk then is the sum of hazard and outrage. The public pays too little attention to hazard; the experts pay absolutely no attention to outrage. Not surprisingly, they rank risks differently.”

Scientists and engineers — the technical experts — can calculate the probability that a given facility will cause death, and because that probability is usually quite remote they conclude the risk is quite low. But the citizens who will live in the shadow of such a facility draw quite a different conclusion. When they inflate the risk, despite scientific evidence to the contrary and despite the fact they ignore even greater hazards in their own daily lives, experts dismiss their complaints as irrational. “The classic example,” says Ken Westlake, Illinois coordinator for the U.S. Environmental Protection Agency, “was the person who complained about emissions from an incinerator while he sat there chain smoking.”

But, as Sandman points out, such behavior is not as irrational as it seems. Ordinary people, he says, tend to see risk differently than the experts. He calls the second dimension of risk “Outrage — all the things people care about other than what will kill them.”

“Risk then,” he says, “is the sum of hazard and outrage. The public pays too little attention to hazard; the experts pay absolutely no attention to outrage. Not surprisingly, they rank risks differently.”

According to Sandman, at the root of stated concerns about property values and physical safety, however legitimate and deeply felt, are issues of trust, fairness, uncertainty, and control. They are issues, Sandman and others say, that touch the heart of the process for determining where to put environmental facilities or certain social institutions, such as prisons or mental health centers, that are commonly regarded as LULUs — "locally undesirable land uses."

LULUs

"People fear the unknown, especially anything nuclear and anything classified as hazardous," says Patti Cronin, executive director of the Wisconsin Waste Facility Siting Board, an agency that mediates disputes between developers and citizens. Don Etchison, the director of the Illinois Department of Energy and Natural Resources, agrees. "Anything that's got nuclear in it has an image problem," says Etchison, who has encountered anxieties that the superconducting super collider — the giant atom-smasher proposed in the far western Chicago suburbs — would leak radioactivity. "People are very afraid of anything radioactive, although it's often an irrational feeling because they don't hesitate to go to the beach and sunbathe despite doctors' warnings that sunbathing causes skin cancer."

But Sandman has an explanation for that seeming paradox: "Diffusion in time and space," he.says, can diminish the perception of risk. Writing last fall in the *EPA Journal*, he explains, "Hazard A kills fifty anonymous people a year across the country. Hazard B has one chance in ten of wiping out its neighborhood of 5,000 people sometime in the next decade. Risk assessment tells us the two have the same expected annual mortality: fifty. 'Outrage assessment' tells us A is probably acceptable and B is certainly not." If Hazard A is sunbathing and Hazard B is a radioactive waste dump, Sandman is certainly correct.

He also notes that "exotic, high-tech facilities provoke more outrage than familiar risks" and that a memorable disaster — on the scale of a Bhopal or Love Canal — generates lots of publicity and makes "the risk easier to imagine, and thus . . . more risky."

"It's perfectly normal," Sandman says. "You see something as a big risk, one that's not fair and not under your control and you look for reasons to stop it. Concerns about health and property values are legitimate, but there are a whole host of other reasons that stem from how you feel about the process under which that LULU is proposed."

"Fairness is a major issue. People feel it's intrinsically unfair that their community gets stuck with, say, a low-level radioactive waste site. Whether or not the risk is little, they are getting a disproportionate share of it. To the extent I feel something is unfair, I translate that into a feeling that it's more risky."

Control and Courtesy

Another relevant factor is what Sandman calls "voluntariness" or, in his words, "The difference between deciding to go skiing and having somebody push you down a mountain on slippery sticks. Going down the mountain is the same; the difference is who chose that you would go down the mountain." Even rewards or incentives may not diminish the outrage of being coerced. "Incentives are useful when outrage factors are low; when outrage is high, they are seen as bribes. We have a long tradition of saying 'Piss on your money' and it's a tradition we care about. It's the difference between a kid being told he has to get a shot and here's a lollipop and being offered a choice whether he gets the shot, with a lollipop as his reward if he decides he will. These sitings are usually coercive and that increases the community's sense of risk."

"Fairness is a major issue. People feel it's intrinsically unfair that their community gets stuck with, say, a low-level radioactive waste site. Whether or not the risk is little, they are getting a disproportionate share of it. To the extent I feel something is unfair, I translate that into a feeling that it's more risky."

Moreover, Sandman argues, those who do the coercing — private developers, the waste disposal industry, government agencies — are often perceived as untrustworthy. "By and large and with good reason, society sees the waste industry and the nuclear industry as not the kind of people you want to invite to your Thanksgiving dinner. They are perceived as arrogant, willing to mislead, and having a record of less than ideal competence. People want to know: Can I trust the people who tell me this is not harmful? Do they listen to me? Do I have reason to believe they are telling me everything they know? For most of these industries, we'd answer no. Just like you wouldn't buy a used car from Richard Nixon, you wouldn't buy a waste facility from most of those who are selling one."

The extent to which the issues of fairness, coercion, and trust enlarge or mitigate citizens' perception of risk depends, Sandman and others say, on public involvement in and control over the siting process. "Most processes are formal, rigid, and ritualistic," Sandman says. "They used to be secret, clubby, and guided by payoffs, so the processes we have now are an improvement. But they still are not friendly. People have the feeling that by the time their opinion is sought, the fix is already in. People look at the process and it's an alien and alienating one and they translate that into risk."

Sandman says students in his Environmental Communication Research Program at Rutgers are conducting a study to measure the connection between the behavior of governmental agencies and citizen perceptions of risk. Students wrote hypothetical news stories about the siting of a hazardous waste facility. In each story the actual health hazard was the same, but the behavior of the agency in charge of the process differed. "Is the government agency arrogant or courteous? Is information given willingly or as a result of lawsuits? Do they treat citizen concerns as legitimate or say 'only an idiot would oppose this'? Agencies feel that if they have a good technical case they don't have to behave very well. But ordinary citizens read those articles and there was a tremendous difference in how they perceived the risk of the facility."

Gloria Craven, an environmental consultant who used to handle public participation for the Illinois EPA, says, "Citizens are looking first for safety, second for equity, and third for some kind of local control. The siting entity has got to be flexible in modifying its plans to meet the concerns of the community. The whole attitude of people trying to site these facilities is changing. No longer do they act like they are the only people with answers. They are willing to work with a community and a community's experts." She cites an instance in New Jersey in which lay citizens were on the committee that helped devise the criteria for siting a resource recovery incinerator. "The people who finally drew the short straw still didn't like it," she says, "but nobody complained that the process was unfair."

The Right Price

Ken Westlake of the U.S EPA notes, "The prevailing wisdom is that you not only need public involvement, you need it early. People have to have some opportunity to gain involvement in making the decisions and even then you may not see any consensus develop." Indianapolis, he says, wanted to build a new landfill for ash from a resource recovery incinerator and for garbage. "They hired a consultant adept at public involvement and got a number of different sectors of the community involved, including 'average' citizens from various geographic locations in the city. They had technical people advising the committee about the prevailing scientific attitudes. It seemed a good, upfront process to develop siting criteria. But when they put the overlay map down on the city showing what areas met the criteria, the bottom fell out of the consensus. There was still a lot of residual feeling of being protective of your own back yard."

Which is why the siting of a sanitary landfill or hazardous waste dump or radioactive storage facility or a prison or whatever often boils down to a matter of economics.

Stephen Goldberg, a Northwestern University professor of law and expert in dispute resolution, notes, "It's a rather simple phenomenon. Whenever any one of us is asked to bear costs for projects that benefit many other people but impose more costs than benefits on us, it is very natural to say: 'Why should I bear these costs?' "

His answer is that they shouldn't — unless the price is right. "There are two approaches to siting these things. The first is you require people to take it; that's the standard approach. The other approach is to treat it like a free market phenomenon — you encourage negotiation until you find a price at which some community is willing to take it and a developer is willing to build it. Say you have a hazardous waste facility. Nobody wants it unless you talk about putting it in an area where the mean income is not very high. Then they'll not only want it, they'll compete for it. The best example is prisons. People who live in communities where there is not much employment welcome prisons. This approach does have some undesirable social consequences. Some people will say, 'That's terrible because poor communities will always end up with these facilities.' " As Peter Sandman points out: "You never see these things going into wealthy communities."

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You may see one going into Martinsville, a tiny southern Illinois farming community in Clark County about thirty-five miles west of Terre Haute, Indiana. In January 1988, the Clark County board, like about two dozen others around the state, voted to tell the state Department of Nuclear Safety that it wanted no part of the agency's low-level nuclear waste disposal facility. But in February, the Martinsville City Council voted unanimously to invite the nuclear waste dump — with its estimated 100 jobs and $1 million a year in fees — to its town. "We need it, and I hope we get it," said Mayor Truman Dean of Martinsville, where unemployment has stubbornly hovered at 11 percent for a decade. "We've always been a poor county, and the town's always been a poor town."

Added merchant Jane Brush: "I'd give 'em my back yard if they'd take it. We've got to do something. This place is dying."

Groundwater: The Invisible Resource

By James Krohe Jr.

Water customers in Marquette Heights near Peoria learned Lesson No. 1 in groundwater pollution when spent chemicals used to treat water from their brand new well leaked back into that well from a storage pit on the surface, contaminating it. When it comes to groundwater, they found, the rule is, "What goes down must come up."

Mining For Water

Groundwater is one of geology's gifts to Illinois. Today nearly half the people in the state rely on water drawn from beneath the ground for their drinking water. More than 1,400 , community water systems use well water, as do the homes, schools, and others who rely on Illinois' 400,000 private wells.

The very topmost layers of the earth dry out after a wet spell like a sponge left out on a counter, but below this "zone of aeration" enough water is present in the soil all the time to supply a family or a farm. Much greater quantities lie in deeper water-bearing formations known as aquifers. For example, buried glacial drift materials such as sand and gravel dot much of the state at shallow depths, mainly along the beds of the rivers (both ancient and modern) which deposited them. Such relatively loose drift deposits can hold vast amounts of water, much the way a drinking glass "filled" with crushed ice still has room for a soft drink.

Below these sand and gravel deposits, extending in most places across northern Illinois to a depth of 500 feet or so, are extensive beds of limestone and dolomite rock; below them, at depths closer to 2,000 feet, are strata of sandstone. Such "solid" rock is in fact suprisingly porous at the microscopic level, and can also hold water in quantity.

The potential combined yield of Illinois' drift and bedrock aquifers is estimated to be 7 billion gallons per day, many times current withdrawals. But while it is abundant overall, Illinois' groundwater is spottily distributed. There are very few sizeable aquifers in the southern counties, for example, where many communities have to rely for water on surface reservoirs. And in crowded northeastern Illinois, aquifers are being overpumped.

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The Illinois State Water Survey has been studying the latter problem in cooperation with the Illinois Department of Transportation's Division of Water Resources. "We're looking at demand throughout the state," explains Ellis Sanderson, head of the Survey's groundwater section. Preliminary results suggest that Illinois doesn't yet need a statewide plan to manage groundwater withdrawals, but that some areas may. About the sandstone aquifers beneath Cook, DuPage, Lake, Kane, and McHenry counties, Sanderson says, "It's a prolific resource, and it's extensively tapped for both public water systems and industry. As a result, we're 'mining' water at a rate two and a half times what that system is capable of producing on a long-term sustainable basis."

Some communities in suburban Chicago have switched to Lake Michigan water, with dramatic results. "Water levels in the formation have risen a couple of hundred feet in some places," Sanderson acknowledges. "But in other places mining goes on, so the net regional effect is continued decline."

A Vulnerable Resource

The experience in greater Chicago has shown that even Illinois' rich groundwater resources are not inexhaustible. "Irrigation is expanding," Sanderson notes of another trend. The withdrawal of huge quantities of water for farm use often puts irrigators at odds with nearby rural water users, local water supply systems, even other irrigators drawing on the same aquifers. Groundwater withdrawals in Illinois still are subject to the old "law of capture," a doctrine which holds that a resource belongs to anyone who can recover it and put it to beneficial use. The state's 1983 Water Use Act, explains Sanderson, laid the basis for the

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← Direction of Groundwater Movement

▨ *Human induced impacts on groundwater*

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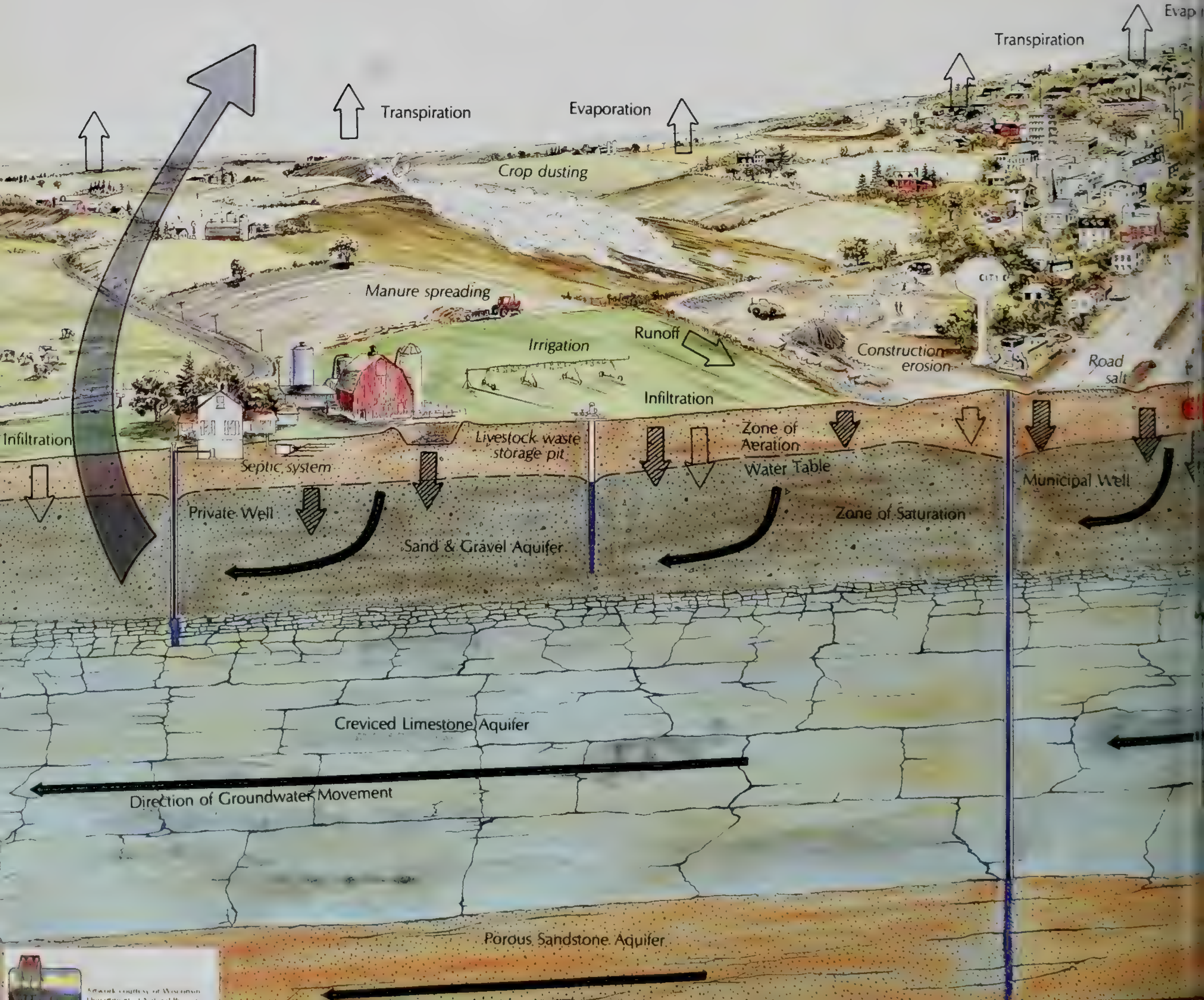
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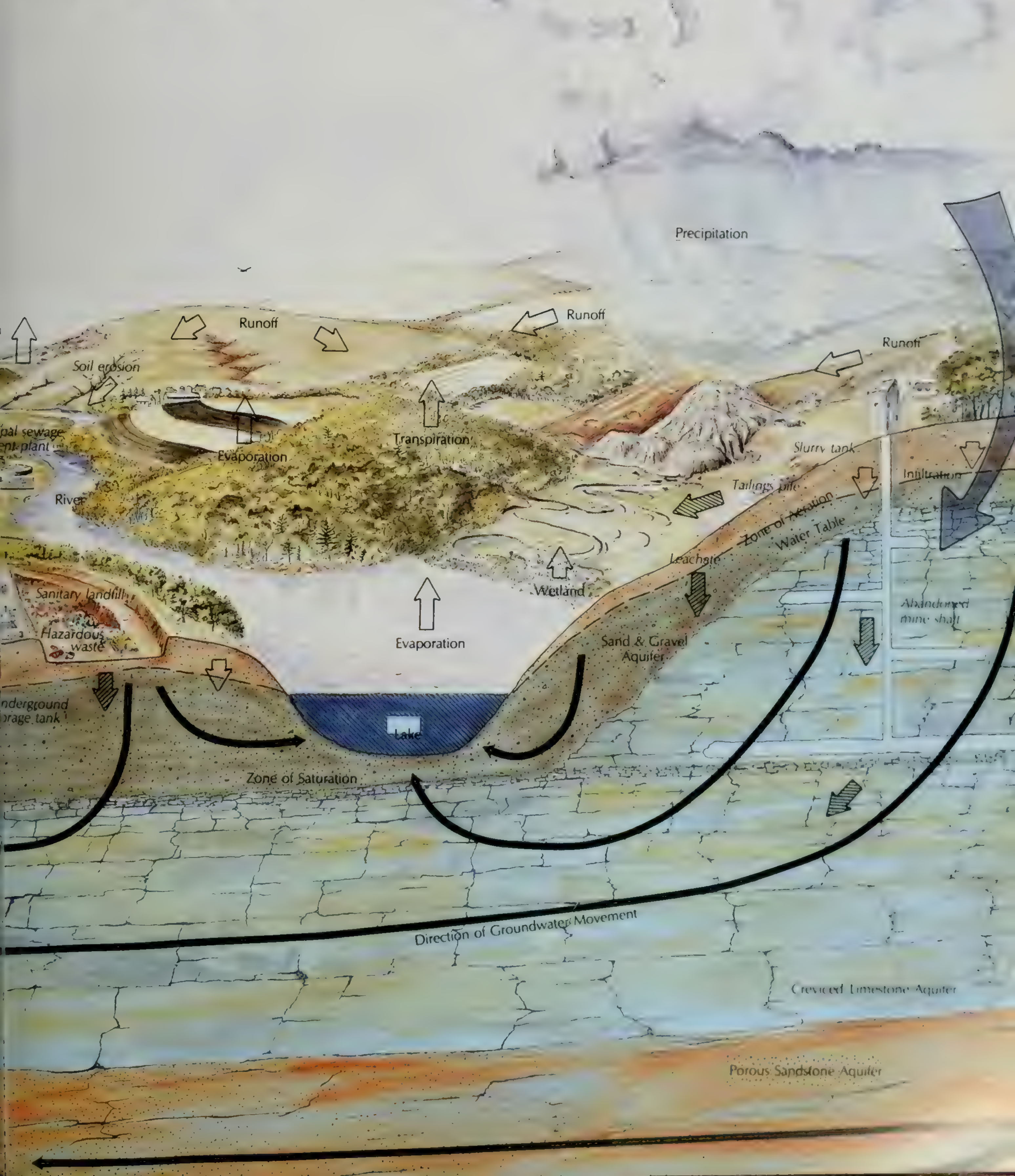
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eventual management of groundwater withdrawals according to the so-called "reasonable use" doctrine which distinguished between artificial wants and natural wants in allocating this limited resource.

Although Illinois' groundwater may be limited, it is not finite, being constantly renewed. Aquifers are one phase of the global hydrological cycle, a temporary resting place for billions of gallons of water as it makes its way from rain clouds to the surface, thence to the oceans and (via evaporation) to the clouds again. Much of the water which falls on Illinois as rain or snow runs off the surface into lakes and streams. But the rest seeps into the earth where it gradually replenishes or "recharges" aquifers.

The pace of an aquifer's recharge varies according to the nature and depth of geologic materials atop it. Water may scoot through sandy soils at a rate of 12 feet per day, while tightly packed clays will slow water movement to less than an inch per day. Shallower aquifers are fed directly by seepage from the surface, while deeper ones are fed by water entering through fissures in the rock above. About the precise effects of soil type or ground cover on the process, however, less is known. "We don't really know a great deal about the mechanism of natural recharge," says Sanderson. "There are lots of questions which have intuitive answers, but research is definitely lacking. Research needs to be performed on a site-specific basis."

Creep or ooze, water moves underground much as it does on the surface. It migrates from higher places to lower ones, and from wet places to dry ones, often across considerable distances; some of the deep aquifers of northern Illinois are recharged by precipitation which falls on Wisconsin. These subterranean sojourns can take a long time. "In the very, very deep layers in Illinois the water is very old," explains John Shafer of the Water Survey's groundwater section. Radioisotope dating has put its age at thousands of years, during which time it accumulates so much dissolved minerals that it becomes as brackish as sea water.

"Groundwater" is a temporary title, because groundwater does not stay underground forever. Where the surface dips below the water table (as it does at a natural spring or where a stream cuts into water-bearing strata) water in the ground emerges to become water on the ground again. In fact, much of the water which keeps many Illinois streams flowing during the parched summer months is actually groundwater.

Nature and Man Pollute

These two aspects of the hydrological cycle — the movement of water from the surface through intervening subsoil materials and the slow speed at which it moves — combine to make the pollution of aquifers an especially vexing problem. Anything dumped on, sprayed over, or buried in the earth atop an aquifer's recharge area can eventually find its way into groundwater. The potential sources of groundwater pollution are thus plentiful and widespread. Broken pipelines. Hazardous waste storage pits. Landfills. Road salt. Gasoline or fuel oil in underground tanks. Pesticides and fertilizers washed off farm fields and feedlots. Richard Berg, an environmental geologist with the Illinois Geological Survey, notes that while flat uplands composed of coarse-grained materials are especially susceptible to pollution — precipitation lingers on flat ground the longest, and soaks in the easiest — the potential for contamination is not limited to them. "Technically, every part of Illinois where a river is not flowing is a recharge area," Berg notes.

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Aquifers are one phase of the global hydrological cycle, a temporary resting place for billions of gallons of water as it makes its way from rain clouds to the surface, thence to the oceans and (via evaporation) to the clouds again.

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Nature does some polluting itself. Calcium, magnesium, and sodium dissolved from rock are among the common contaminants of Illinois groundwater. They can render such water unpleasant tasting, even unhealthful in high concentrations. Much of the early research done by the Illinois Water Survey sought to learn how to treat such water, both to protect public health and prevent destructive scaling inside boiler systems using "hard" water. Luckily, most natural pollutants can be removed by conventional water treatment.

And manmade pollutants? For a long time it was thought that groundwater was purified as it percolated through soil layers during recharge. Fine soil particles like clays do indeed act like fine sieves, filtering bacteria and other large contaminants. Some contaminating molecules become strongly attached, or adsorbed, to these fine particles as a result of electrostatic attraction, much the way lint becomes attached to a static-y sweater, and so do not travel much past the clay layers near the surface. Unfortunately, some manmade chemicals such as solvents penetrate even clay.

Nature's armor against groundwater contamination, alas, is riddled with such chinks. Abandoned wells which once brought water out of an aquifer, for example, can become routes by which pollutants can enter. Injection wells sunk deep into the earth like giant hypodermic needles dispose certain industrial wastes into bedrock lying below aquifers; a faulty or damaged injection well, however, can leak waste into shallower adjacent strata as well. Sand and gravel pits, stone quarries, sewer lines, oil and gas transport lines, oil wells, storage pits, old coal mines — all can become routes by which pollutants enter underground water formations.

A Drop Of Prevention

The extent of the resulting contamination is not precisely known and needs to be evaluated on a case-by-case basis. While the testing of Illinois drinking wells for the presence of such conventional pollutants as bacteria has been done for years, testing to find heavy metals or pesticides has only recently begun on a systematic basis. The Illinois Environmental Protecton Agency (IEPA) set up a system to sample and analyze water from community wells in 1985. The IEPA and the Department of Public Health (IDPH) also test drinking water on an occasional basis for pesticides and other farm-related pollution such as nitrates.

Test results to date show no statewide crisis in groundwater quality, but they are unsettling nevertheless. By the spring of 1987 more than a thousand samples drawn from community wells had been analyzed; eight percent showed some chemical contamination. Roughly a quarter of the 15,600 private wells tested by the IDPH in 1986 had higher than desired bacteria levels and 12 percent had excessive nitrate concentrations. Tests conducted in response to citizen complaints found another three dozen or so drinking wells contaminated by either farm chemicals or gasoline.

Many manmade chemicals are believed to be toxic at such extremely low concentrations that only a little of them can render groundwater unfit to drink. Drop a single tablespoon of TCE, or trichloroethylene — a common solvent used in dry cleaning and other operations — into a typical water tower tank and every drop of it will exceed by ten times the federal TCE standard of 5 parts per billion.

Worse, once groundwater gets polluted it stays polluted for a long time. Pollutants spread slowly underground from their point of origin in a gradually enlarging "plume." Contaminant plumes move no faster than the water which carries them, and so can take years to move out of some aquifers. A broken pipeline spewed gasoline into a sand and gravel aquifer near Creve Coeur in suburban Peoria in 1957; water from a nearby municipal well showed detectable levels of gasoline during the next four years.

When it comes to groundwater pollution, in other words, a drop of prevention is worth a gallon of cure. As Department of Energy and Natural Resources director Don Etchison puts it, "Groundwater is an extremely valuable resource that has been too long neglected and taken for granted. There is growing recognition here in Illinois and throughout the nation that comprehensive groundwater protection measures are vital."

Regulation and Research

Until recently, Illinois' legal protections against such pollution were pretty leaky themselves. Not all things that contaminate groundwater were regulated, and those that were, were regulated by different agencies in different ways. In 1987, however, the General Assembly passed and the Governor signed the Illinois Groundwater Protection Act. Among its many provisions the new law provided for cooperation among the half-dozen state agencies regulating groundwater, called for new information-gathering to better define the problem, widened regulatory authority over potential pollution sources, and mandated new standards for groundwater quality.

Two features of the new law should provide what the IEPA calls "baseline" protections. Most of the recorded instances of groundwater pollution have been traced to sources well within recharge areas. Storage and loading depots for farm chemicals have often proven to be culprits, as have buried gasoline tanks and landfills. The act thus established "protection zones" through mandatory setbacks around wellheads. Setbacks reduce the potential for pollution by keeping pollution sources outside aquifer recharge areas. No new drinking well may be sunk within 200 feet of an existing pollution source, according to the act, and no new facility representing a potential source of pollution may be sited within 200 feet of an existing well. The act also established the legal authority by which local officials or the IEPA (acting through future regulation) may set up larger protection zones extending up to 1,000 feet from community wells.

IGPA

Illinois Groundwater Protection Act

Much of the responsibility for groundwater assessments and other research needed to implement the new groundwater protection act falls on the Water and Geologic Surveys. "Where are the vulnerable recharge areas? What upland areas are especially susceptible?" asks the Geological Survey's Berg. "What we have to do is map the state's geology in detail, on a 1:24,000 scale." Waterwell logs provide much information about subsurface materials — Berg compiled a map of the state's shallow aquifers in 1984 using data from 25,000 such records — as do records of engineers' test borings. "We may have to drill our own wells in some places. Then we can classify areas according to whether thay have permeable materials with a high potential for contamination."

John Shafer at the Water Survey adds that combining geologic data with data compiled for other purposes by environmental regulators, hydrologists, and others can reveal those parts of the state where dependence on susceptible aquifers combined with high densities of industrial operations suggest a high risk of groundwater problems. Shafer notes that preliminary work by the Surveys show the Rockford, Metro East, and Peoria areas to be among those with the highest potential for groundwater pollution.

Referring to hydrogeologic assessments of those metropolitan areas plus other similar work in Kankakee and Kane counties, Sanderson says, "We hope to establish some framework for understanding regional contamination. For example, we don't yet know what kind of network we need to monitor groundwater on a regional scale." In addition to mapping, monitoring, and assessment, the Surveys are required by the new act to look specifically at the effects pesticide use is having on groundwater. "There's really been only a little work done in Illinois in that area," Sanderson notes.

Like any regulatory scheme, the state's new groundwater protection programs will only be as good as the information used to implement them. Sophisticated computer models have been devised which predict the effect of management decisions on aquifer draw-down, for example, or simulate the movement of contamination plumes underground, but their success depends on how much information is available to put into them

"We're going to take a look at what we know and what we don't know," explains Sanderson, "and how to go about learning what we don't know

Natural RESOURCES DIGEST

WILDLIFE

The Losing Edge: Woodland Birds In Illinois

Two hundred years ago as much as 40 percent of the Prairie State's land was covered with forests — in the south, in the northeast, and along its major rivers. The pioneers arrived and began clearing away the forests for timber and agriculture. As those settlers arrived, many Illinois species departed. Woodland birds like the Carolina parakeet became extinct, while the pileated woodpecker retreated farther and farther.

Now less than 10 percent of Illinois is forested, with the only major unbroken tracts of timber located in the southern part of the state in the Shawnee National Forest. Even these tracts are less than a few thousand acres each. Most of Illinois' wooded areas are found in woodlots scattered throughout the state.

The Fragmented Forest

Ornithologists have long been worried about the fate of those birds that breed in Illinois in the spring and summer and migrate to the tropics in the winter. Their concern originally focused on habitat destruction in Central and South America, where tropical deforestation is accelerating at a frightening pace. Further study revealed dangers closer to home, in the breeding grounds of woodland birds throughout North America.

Wildlife management specialists once believed that habitat heterogeneity benefits wildlife through the "edge effect." These managers tried to break up large homogeneous patches of forest to improve wildlife habitat. Game animals thrived because of this practice, since they needed a mixture of habitats throughout the year. In addition, studies of forest succession showed that bird species reached maximum diversity in a fragmented forest, and many non-game species depended upon forest edge. Part of this effect was thought due to an increased local diversity of foraging and nest sites. Evidence also suggested that migrating birds concentrate along habitat edges and in disturbed areas.

Over the last decade this view of bird species management has come in for questioning, particularly from those scientists studying non-game animals. Two patterns have emerged which bolster their case.

First, the population densities of non-game birds are declining in small woodlots. Many birds that winter in the tropics, such as warblers, tanagers, thrushes and vireos, have declined by as much as 90 percent in woodlands scattered throughout North America.

The second pattern yields evidence that tropical deforestation is not yet having a major impact on bird population, although this will almost definitely be a problem in the future. The evidence suggests that woodland species' greatest enemy is forest fragmentation in their breeding grounds. The irony, of course, is that forest fragmentation is exactly what wildlife managers are promoting when they manage for more forest edge.

A Suite of Birds

Scientists like Dr. Scott Robinson of the Illinois Natural History Survey (NHS) are discovering that the entire suite of birds that one should see in a forest is lacking in forest fragments. The birds that are suffering the most are woodland birds, Illinois' songbirds. They are suffering for a variety of reasons.

First, small habitat patches contain a disproportionate number of generalist species, non-forest birds like the grackle and cowbird. These birds, which can just as easily live in farming areas, invade the areas of habitat specialists like the wood thrush and compete with them for food or act as predators.

Second, nest predators which live in farms or in the suburbs and other areas with non-continuous forest also thrive in woodlots at the expense of specialized woodland birds. These include raccoons, opossums, and squirrels, as well as neighborhood cats and blue jays. The jays are a special problem, with their numbers increasing nationwide as a result of the increased popularity of bird feeders. Recent studies have shown an astonishingly high — up to 80 percent — rate of nest predation in forest birds. Nest predation is higher along habitat edges than in the forest interiors, mostly because many potential nest predators favor habitat edges.

Third, many woodland species nesting in small woodlots fall prey to the brown-headed cowbird, a brood parasite that lays its eggs in the nests of other species. Cowbirds parasitize more than 200 species of birds including about two-thirds of Illinois' woodland songbirds. Some species simply throw out any foreign eggs deposited in their nests, but most accept the cowbirds' eggs as their own and thus lose reproductive success.

"Sixty-five percent of all nests we have looked at have at least one cowbird egg," relates Dr. Robinson. "The average in Illinois is two and one-half cowbird eggs per nest, and some species' nests have been completely parasitized. Birds like the scarlet tanager have been very hard hit. Larger woodlands offer protection from cowbirds, forcing them to travel farther to and from foraging areas. Neotropical migrants need large homogenous unbroken patches of forestland. Many game birds need the opposite. Wildlife managers need to look at game and non-game animals and take both into account."

New Management Needed

In a two-year study funded by the Army Corps of Engineers to explore the effects of recreational and game management on non-game birds, Dr. Robinson and his research team worked to determine the effect of edge on woodland birds along Lake Shelbyville. The areas of land managed by the Army Corps and the Illinois Department of Conservation along the border of the lake contain over 15,000 acres of upland habitat, making the lake one of the two or three largest areas available for wildlife management in central Illinois. Small woodlots and thickets border the lake and form an archipelago of small habitat islands in a sea of corn and soybeans.

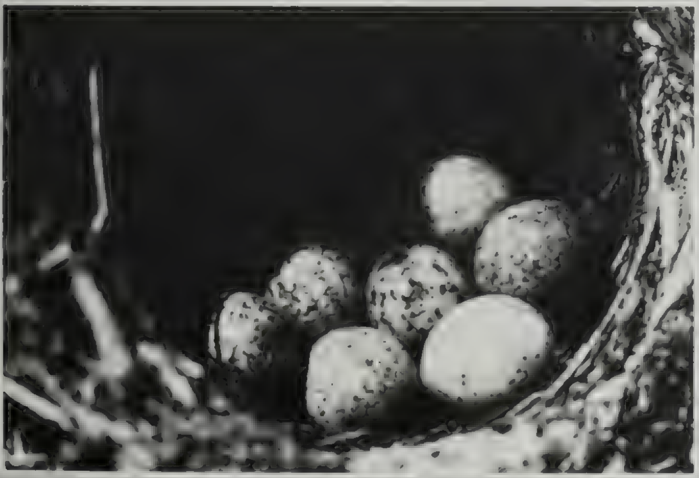
The NHS researchers used three methods to measure frequency of bird species: bird censuses, mist-netting (a very fine nylon mesh net six and one-half feet tall and 40 feet long is spread across the forest, and birds fly without harm into bags enmeshed in the net), and nest monitoring.

The results confirm the fears of many ornithologists. The overall predation rate on 145 nests located in 1985 and 1986 in the research area was over 80 percent, a figure twice as high as the usual predation rate for songbird nests. Sixty-six percent of all nests that accept cowbird eggs were parasitized, one of the highest rates ever recorded. Most nests were, in fact, multiply parasitized: they averaged 2.6 cowbird eggs and only 2.3 host eggs per clutch.

"The wood thrush, a bird with a very beautiful song, presented one of the grimmest pictures in our study," Robinson states. "Wood thrushes nest in most woodlands, but accept cowbirds and have only one or two opportunities to breed before they return to their winter grounds in the tropical forests of Central America. In 1985 we made a concerted effort to find wood thrush nests in two small woodlots. Of the 15 such nests located, each contained at least one cowbird egg. One nest had 11 cowbird eggs, the world record for this species. The female wood thrush incubated the whole clutch and hatched only a single cowbird. Overall, these nests averaged 3.8 cowbirds and only 1.1 thrush eggs per nest. They fledged 11 cowbirds but only two wood thrush young."

"Given these conditions, it is remarkable that any songbirds survive around Lake Shelbyville. The best way to avoid the regional loss of bird species diversity that we are facing may be to develop management plans centered around native habitat specialists like the wood thrush. Managing for species restricted to a particular habitat should help guarantee the continued existence of all the species that depend on that habitat. In any event, we need to completely re-think the management strategies we have used over the past forty years."

This article is excerpted from the work of Dr. Scott Robinson, an ornithologist and assistant wildlife ecologist who joined the Illinois Natural History Survey in May of 1984. He received his PhD in Biology from Princeton University. In addition to his work on woodland birds in Illinois, he has conducted extensive research on migrant birds in their wintering grounds in the tropics.


Dr. Scott Robinson — INHS

A wood thrush nest with 10 cowbird eggs.

Dr. Scott Robinson — INHS

The brown-headed cowbird, which lays its eggs in the nests of many of Illinois' songbirds.

BIORHYTHMS

Squelching the Squash Bug

A computer model that simulates the growth of a squash bug population during a growing season has been developed. The squash bug is a major pest of pumpkins and squash in Illinois, the leading state in production of pumpkins for processing. Data gathered from three years of research into the biology of the squash bug was used to construct the model. The model was used to predict the impact of various planting dates on bug populations and to determine the most efficient timing of insecticide applications.

Researchers Share Information on Migration and Dispersal of Insects and Other Organisms

NHS researchers have taken the lead in organizing a north central regional committee to study the migration and dispersal of insects and other biotic agents. In a recent meeting 27 scientists from 12 states gathered in Chicago to share research experiences and formulate operating objectives. The group is comprised of a unique mixture of entomologists and meteorologists. The entomologists are interested in movement of arthropod vectors of plant or human pathogens, or of major direct pests such as the potato leafhopper or various noctuid moth pests of corn. The meteorologists provide the integral link for understanding the environmental forces that act upon target pests.

A Case of Mistaken Identity

When is a blacknose shiner not a blacknose shiner? When it's in Tennessee. A study by Dr. Lawrence Page, ichthyologist at the NHS, was recently conducted to determine why the blacknose shiner fish was thriving in Tennessee, but was an endangered species in Illinois. The results of the study showed that the Tennessee population is genetically different from other populations and in fact, is not even the blacknose shiner. It is a distinct species, similar to and closely related to the blacknose shiner, but it differs in a number of morphological characteristics including body shape, and numbers of scales and gill rakers. The Tennessee species, now described and named the bedrock shiner by Dr. Page, also differs from the blacknose shiner in its ecological characteristics.

The study resulted in the recognition and naming of a new species, and revealed that researchers cannot look to the Tennessee population for management suggestions applicable to Illinois populations. Researchers also learned that all of the southern populations of the blacknose shiner are declining and there is an even greater urgency in protecting those that remain.

Pheasants Considered "Homewreckers," Especially by Prairie-chickens

The threat by pheasants to the preservation of Illinois' remaining prairie-chickens continues to prompt pheasant control on sanctuaries in Jasper County. A successful controlled shoot was conducted by the Ill. Dept. of Conservation in January of 1987, followed by opportunistic shooting of pheasants.

Subsequent censuses and intensive nest studies showed that the count of crowing pheasant cocks was down and the density of pheasant nests on sanctuaries also declined, while the decline in number of prairie-chicken cocks and nest density was not as great.

Despite intensive control efforts, however, the pheasants continued their home-wrecking ways by depositing their eggs in prairie-chicken nests. This continued high level of parasitism was due to a reported release by local individuals of 56 hen pheasants in early April. Typically, the survival of released pheasants is low, but the released birds evidently survived long enough to do what pheasants do best — parasitize nests of their own kind, plus those of other species.

Six of the nine parasitized prairie-chicken nests in 1987 were found in time to remove the pheasant eggs before the ultimate nest fate was determined. One chicken hen was found trying to cover 26 eggs, 15 of her own, plus 11 pheasant eggs. This hen, plus four others of the six cleaned up nests, were successful in producing young prairie-chickens.

Presto! Chango! Fossil Charcoal Turns into Manganese Dioxide

Nodules of manganese dioxide are common in the Franciscan Complex soils located in the coastal areas of California. Formation of the nodules is usually attributed to bacterial activities or combined hydrothermal-volcanogenic activities. The possibility of another alternative is being studied by Dr. K. Robertson, a member of the NHS's section of Botany and Plant Pathology, and Dr. D. Johnson, from the University of Illinois' Dept. of Geography.

In soil samples containing both fossil charcoal and manganese dioxide nodules, the researchers, using light microscopic and scanning electron microscopic techniques, have shown that the fossil charcoal is transformed into manganese dioxide. Through continuing research, the investigators are attempting to identify the specific processes responsible for the transformation.

NHS Pathologists Find the Cause of a Leaf-Spotting Disease

The fungus that causes a leaf-spottng disease that results in annual severe defoliation of red and yellow-twig dogwood shrubs has been identified by NHS plant pathologists. Mycological and biological studies of the disease and its causal organism were conducted from 1985 through 1987 by Dr. D. Neely and graduate student D. Nolte.

The causal fungus has been identified as *Septoria cornicola*. The disease is first noticed in June. By July most of the leaves are affected and in August, the leaves drop from diseased shrubs. The outer canopy leaves are affected first and most severely.

The disease can be controlled by fungicide application.

Personnel Notes

Dr. Frank Bellrose, principal scientist at the Natural History Survey, recently celebrated 50 years of service. On February 1, 1988, the NHS held a reception to recognize Bellrose's record. Although semi-retired as of August 31, 1982, Bellrose continues to work on a part-time basis to complete several of his long-term research projects, especially a book based on nearly 50 years of research on the wood duck.

What Do You Call It When Feathered Friends Get Together?

A bank of swan.

A bunch of widgeon.

A brood of grouse.

A bevy of quail.

A band of jays.

A coil or spring of teal.

A covey of partridge.

A crowd of redwings.

A fall of woodcock.

A fleet of coots (mudhens).

A flight of plover.

A gaggle of geese.

A paddling of mallard.

A rafter of turkeys.

A sedge of herons.

A tribe of sparrows.

A whisp of snipe.

CURRENTS

Acid Rain Effects Overestimated

Effects of acid rain on the environment have been overestimated, according to Edward Krug, Water Survey researcher. "In fact," said Krug, "the very soil said to be tainted with high levels of acid from acid rain actually produces its own acid during natural soil formation. The results of this natural soil formation are those attributed to acid rain: leaching of nutrients, release of aluminum, and acidification of soil and water."

Krug maintains that data are often interpreted and presented in such a way as to overestimate the effects of acid rain on the environment. Of the 1,620 lakes in the eastern United States that were examined by the Environmental Protection Agency to determine how widespread the problem of lake acidification is, only 75 were found to be acidic (pH less than 5). This is a surprisingly low percentage, according to Krug, especially considering that only the areas most likely to have acidic lakes — such as the Adirondacks in northeastern New York State — were studied.

Krug believes that when proposed federal acid rain legislation requiring reductions in emissions of acid-forming sulfur is being considered, the extent of acidification of soils and water due to natural causes must be taken into account.

Oil Spill not Detectable in Illinois

Diesel fuel from a January tank collapse at Jefferson, Pennsylvania, was not detectable in water samples taken from the Ohio River in southern Illinois at the beginning of February.

After the tank collapsed on January 2, one million gallons of fuel oil spilled into storm sewers and eventually entered the Monongahela River, and then the Ohio River.

By January 20, officials were having difficulty visually tracking the spill. They lost track of it upstream of Illinois, but predicted that it would reach the state by February 1.

From January 31 through February 3, Water Survey hydrologists collected water samples from the Ohio River at Shawneetown. Lab analyses showed no indication of elevated levels of naphthalene, a component of the fuel oil.

"We couldn't collect samples after February 3 because of rising water levels," said William Bogner, hydrologist. "Traces of the oil may have arrived later. In any case, the oil would no doubt have been too diluted to detect. Before reaching Illinois, the spill traveled 850 miles and passed through 20 locks and dams."

Stabilizing the Bluffs

One of the major causes of sediment buildup in Peoria Lake is severe erosion of the bluffs bordering the Illinois River. A new state-funded project is aimed at stabilizing these rapidly eroding bluffs with low-cost methods.

"Several types of stabilizing techniques are being used," said Don Roseboom, head of the Water Survey's monitoring effort. "These techniques rely heavily on manpower and low-cost materials. They include strategically placed railroad ties, rock, used tires, and gabion baskets." Gabion baskets are wire cages containing rocks.

The test structures were designed by Owne Ingram, a retired Soil Conservation Service district conservationist.

Volunteers affiliated with Project Chance, administered by the Illinois Department of Public Aid, installed the structures. Project Chance gives individuals an opportunity to develop work skills and obtain experience to help them re-enter the labor force in their area.

Vegetation also will be used to control erosion. Thick, well-rooted vegetation such as willows, sycamores, perennial grasses, and legumes will be planted.

Water Survey staff members conducted an initial survey of the bluff areas before the stabilization work began. In another three to four years another survey of the area will be done to determine the effect of the various stabilization techniques on the erosion of the bluffs.

Keeping Their Eyes on the Skies

Nearly 175 National Weather Service cooperative weather observers located throughout the state provide a valuable public service by faithfully recording daily weather conditions.

The observers, all trained and certified by the National Weather Service, are farmers, government employees, retired persons, lock and dam workers, and other Illinois residents who represent many occupations. "Thanks to weather observers, we have good quality, dense weather records for Illinois since about 1900," says Water Survey climatologist Wayne Wendland, who is also the Illinois State climatologist. Wendland's repository of information on Illinois weather dates back to the 1880s, but "when we consider modern records and our own experience, we see that some early reports are not believable." Wendland uses the weather data from observers to help answer questions and interpret weather data. He also prepares a monthy weather summary based on the observers' reports.

CENTERING ON WASTE

Incentives Offered To Illinois Businesses And Others For Reducing Hazardous Wastes

The Governor's Innovative Waste Reduction Awards and the Recycling and Reduction Technologies (RRT) Matching Funds Program are two of the most vital components of the Hazardous Waste Research and Information Center's waste reduction program. The latter is a program that awards matching funds to industries for developing methods that reduce or recycle hazardous wastes.

The Governor's Awards are presented to industries that have already incorporated waste reduction technologies into their production facilities and have significantly reduced the amount of hazardous waste they generate.

HWRIC is currently soliciting applications for both the 1988 Governor's Awards and the FY'89 RRT Matching Funds Program. Interested persons and companies are encouraged to apply as soon as possible.

The goal of these programs is to encourage waste reduction, according to HWRIC Director David L. Thomas.

"Both of these programs are aimed at encouraging companies to reduce their waste. And both are providing the state with information on current and new waste reduction practices; this information will in turn be disseminated to others in the state to encourage them to do likewise," Thomas said.

Recycling, Reduction, and Technologies Matching Funds Program

The Center's RRT matching funds can help Illinois industries improve or develop their own waste reduction or recycling technologies. These funds are awarded to industries and other generators of hazardous wastes, such as hospitals and laboratories; engineering consultants; and private and public research institutions. In the past HWRIC has funded projects up to $20,000 each and has allocated a total of $100,000 a year for these projects. In Fiscal Year 1989, HWRIC will consider proposals for projects up to $50,000 each. The matching fund program emphasizes applied, practical research.

"Our goal is to end up with a product that businesses can use in their own production processes," says HWRIC Industrial Assistance Engineer Dan Kraybill.

"For example, Bill Smith Inc. (BSI), a Champaign consulting firm, has made modifications to a small still purchased by an analytical laboratory for distilling solvents. The modifications permit the recovery of technical-grade solvents for use in laboratory analyses. By distilling these solvents, the lab can reduce the amount of hazardous wastes it produces; this in turn saves the lab high hazardous waste disposal fees. In addition, the lab saves money by reducing the amount of new solvent it must buy," he said.

The BSI project is just one example of the types of research that may be conducted using these funds. Other eligible projects include those that:

- detoxify hazardous wastes;
- reclaim hazardous wastes on or off site;
- recycle hazardous wastes on or off site;
- minimize the amount of hazardous waste generated through process modification or improved housekeeping; or
- achieve a high degree of innovation in hazardous waste treatment.

1988 Governor's Innovative Waste Reduction Awards

This is the third year that the Governor's Awards will be presented. These awards were created to recognize the efforts Illinois industries and others are making to minimize the volume of hazardous wastes they generate," Thomas said. "They also encourage Illinois industries, both large and small, to develop and use new waste reduction technologies or improve existing methods."

Those who would like more information about either of these programs or who have questions about applying for the awards or the grants, are encouraged to call HWRIC at 217/333-8940.

Contamination Found in Chicago-Area Waters

According to two studies recently released by HWRIC, Lake Calumet in Cook County and Waukegan Harbor in Lake County are contaminated from past industrial activity with chemicals toxic to various microorganisms.

The area in and around Lake Calumet has become a "severely disturbed ecosystem" and could present a danger to the surrounding environment, according to one report. Researchers in this multidisciplinary study found that concentrations of toxic metals and organic pollutants were higher in Lake Calumet than in nearby water bodies, and sediment extracts collected at lake sampling stations were found to be toxic to organisms similar to those found in the lake.

Waukegan Harbor, one of Illinois' most important Lake Michigan ports, is contaminated with PCBs (polychlorinated biphenyls) and its contaminated sediments are toxic enough to pose a potential threat to the harbor's ecosystem, according to researchers in the HWRIC-sponsored study. But this study, headed by Dr. Philippe Ross of the Illinois Natural History Survey (INHS), has also revealed that PCBs may not be the only source of toxic contamination in the harbor — a number of complex factors may be causing the toxicity.

Further studies on Waukegan Harbor and Lake Calumet are being planned by HWRIC.

"The results of these studies will give us a much more complete picture of the effects of the contamination in Waukegan Harbor and Lake Calumet and will therefore be of value for making decisions about cleaning up these areas in the future," HWRIC Director Dr. David L. Thomas said.

Copies of these two reports, "Assessment of the Ecotoxicological Hazard of Sediments in Waukegan Harbor" (HWRIC RR 018) and "A Preliminary Environmental Assessment of the Contamination Associated with Lake Calumet, Cook County, Illinois" (HWRIC RR019) can be obtained by calling HWRIC at 217/333-8940.

Ground Breaking For Hazardous Materials Laboratory Set for May 1988

Ground breaking for ENR's state-of-the-art Hazardous Materials Laboratory (HML), which will house the Hazardous Waste Research and Information Center, is scheduled for late May 1988 on the Champaign campus of the University of Illinois.

The new laboratory, which should be completed in the fall of 1989, will provide facilities where Illinois researchers, scientists, and engineers can safely study and handle hazardous materials and wastes.

The importance of the HML will eventually extend beyond Illinois' borders, according to HWRIC Director Dr. David L. Thomas.

"The lab will focus on Illinois and regional issues, but many of these will apply at the national level as well. The federal government is attempting to work more cooperatively with the states, and there is a possibility that the U.S. Environmental Protection Agency will use the laboratory and provide some funding in the future," Thomas said.

Work carried out in the lab will benefit a broad spectrum of Illinois' citizens, says HML Manager Marvin D. Piwoni.

"The motivation for constructing the HML is to provide a research facility in which the state's various public- and private-sector research groups can work to solve the crucial problems of hazardous waste contamination and waste reduction. This will ultimately improve both the environment and the quality of life for Illinois citizens," he said.

GEOGRAMS

Map Series 60 Years in the Making!

Initial completion of 7.5-minute, 1:24,000-scale U.S. Geological Survey (USGS) map coverage of Illinois, a milestone in mapping, was celebrated on March 11 in Springfield.

Twenty-four recently published topographic maps of an area in east-central Illinois round out the 1,071-map series, which began in 1928, as a cooperative effort of the Illinois State Geological Survey (IGS) and the U.S. Geological Survey.

"Such detailed, accurate, up-to-date maps are essential tools for planning and managing the state's economic and natural resource base," said Lowell E. Starr, Reston, Va., chief of the U.S. National Mapping Division. The maps will be revised as required to document changes in uses of land and in topography, or to meet changing requirements of resource planners and managers. Approximately $100,000 a year will be required from the State of Illinois for the topographic map maintenance program.

Copies of the Illinois maps can be purchased from the Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820 or 217/333-4747 and from other map dealers in Illinois. To obtain a topographic map index, free of charge, call or write the Geological Survey, which will send an order form price list along with the index.

Research Presented at International Conclave

Research efforts on the "Abundance and Origin of Major Minerals in the Herrin Coal of the Illinois Basin" show that the greater portion of minerals appear to be derived from the original plants from which the coal was made. The absence of characteristics and properties typically found in river-deposited sands and muds led to this conclusion, according to Dr. Richard D. Harvey, senior geologist in the coal section of the Illinois Geological Survey.

Harvey shared his findings and those of his colleagues Drs. Ilham Demir and Chen-Lin Chou, also IGS geologists, at a technical session during the international conference on the Mineral Matter in Coal Ash.

The Survey's research focused on the quantity of various minerals in Illinois' principal coal seam and how concentrations of certain deleterious elements can be predicted in areas of the state. Using many samples, IGS researchers sought the geological reasons for mineral occurrences on a regional basis and looked for distribution patterns as well.

Damage to Chicago's Shoreline Assessed

The record-high water in Lake Michigan in the spring of 1987 created heavy demands at the Geological Survey for information about shore protection measures and other aspects of the geology of the Lake Michigan shoreline. A U.S. Geological Survey/Illinois Geological Survey cooperative pilot study during the fall of 1987, using side-scan sonar devices aboard the USGS' research vessel R/V NEECHO showed significant undermining and other hidden damage to shore protection structures in the Chicago region.

The IGS has reported to the Chicago Shoreline Protection Commission that, of the 25 miles of shoreline in the Chicago region, 11 miles of shore protection structures are so severely damaged that they require immediate remedial action to prevent severe damage to shore structures, and five more miles of structures will require reconstruction in the near future to prevent further destruction and undermining. More than nine miles of beach should be rebuilt through replenishment of sediments, and at least three miles of new breakwaters should be constructed. Although the remainder of the 63 miles of Lake Michigan shoreline in Illinois is fairly well protected, the shoreline damage inventory showed that a total of approximately one more mile of rehabilitation work should be added to each of the damage assessment categories to properly protect the entire Lake Michigan shoreline in Illinois.

Personnel Notes

Dr. Robert A. Griffin, Ph.D., has been named principal chemist and head of the Chemistry and Minerals Engineering Group at the Illinois Geological Survey (IGS). In that position, he succeeds **Dr. Neil F. Shimp, Ph.D.,** who retired after 30 years of service.

Griffin, who most recently was geochemist and head of the Groundwater Section at the IGS, received B.S. and M.S. degrees in soil science from the University of California at Davis and a Ph.D. in soil chemistry from Utah State University at Logan. Joining the Survey in 1973 as a research associate, Dr. Griffin was named associate geochemist three years later. In 1978, he was promoted to geochemist and head of the Geochemistry Section.

Dr. Shimp, who joined the IGS as an analytical chemist in 1957, received his master's from Michigan State and his doctorate in soil chemistry from Rutgers University. He was named head of the Analytical Chemistry Section in 1963.

Among his accomplishments, the recent retiree planned for and installed the first generation of instrument-trained chemists and their equipment. Ten years later, he was named head of the Chemistry and Minerals Engineering Group. Convinced that successful laboratory research often dies for lack of adequate engineering and process development, he worked toward expanding the Survey's applied research capabilities to enable the IGS to carry out small-scale demonstration projects.

Shimp supervised the establishment of the Geological Survey's first environmental chemistry laboratory and maintained a strong interest in research on the accumulation and distribution of potentially hazardous trace elements. He was actively involved with coal research and played a leading role in the Survey's cooperative efforts with the American Society for Testing and Materials and the International Standards Organization to establish quality standards for coal. Dr. Shimp was instrumental in establishing the Center for Research on Sulfur in Coal, a cooperative research center, and served as its first (acting) director in 1982.

SHORT TAKES

SSC Representatives Visit Illinois' Proposed Site

Superconducting Super Collider representatives from the U.S. Department of Energy (DOE), and its contractors completed a visit in March to Illinois' proposed site as part of their work in preparing an Environmental Impact Statement. More than 30 DOE staff and contractors spent a week learning about the state and independently gathering information about the Kane, DuPage and Kendall counties area where the SSC would be located.

DOE is visiting each state listed as best qualified for siting the SSC: Illinois, Arizona, Colorado, Michigan, North Carolina, Tennessee and Texas. Announcement of the preliminary site for the SSC is expected from DOE in November 1988, with final confirmation in January 1989. Construction is expected to be complete in 1995.

The SSC is a particle accelerator to be built in a 10-foot diameter, 53-mile racetrack-like tunnel. If the SSC is built in Illinois, it would be located in bedrock about 400 feet beneath Kane, DuPage and a small portion of Kendall counties, and would be based at Fermilab near Batavia. The $4.4 billion project would accelerate particles of matter to nearly the speed of light and force collisions with an energy of 40 trillion electron volts. Scientists would study the fundamental nature of matter and energy through observation of the subatomic particles created by the collisions.

Site Near Martinsville Undergoes Suitability Studies for a LLW Disposal Facility

The Illinois Department of Nuclear Safety (IDNS) announced it will begin studies to determine if a site near Martinsville in Clark County is suitable for a low-level radioactive waste (LLW) disposal facility. Support for establishing the facility in that portion of Clark County has gradually increased, as four townships and two school boards in the Martinsville vicinity joined the village board in passing favorable resolutions. The decision to undertake suitability studies, which are expected to take about 18 months, followed successful preliminary tests of three potential sites near Martinsville. A decision on whether the Martinsville site is suitable for Illinois' planned LLW disposal facility is expected by late 1989.

Illinois, which joined Kentucky to form the Central Midwest Interstate LLW Compact, is required to have a new disposal facility in operation by 1993, when the country's three existing facilities will no longer be accessible to LLW generators in the two states.

Standards for the facility's operation call for no additional radioactivity to be released into the environment. IDNS Director Terry Lash said these rules are the "most stringent of their kind promulgated by any government agency in the country."

Prairie Volunteers Celebrate 10 Years of Hard Work

The North Branch Prairie Project, the first volunteer prairie management group, celebrates its ten year anniversary this spring. Since its inception the group has restored and managed more than 150 acres. Their example has also fostered an innovative partnership between The Nature Conservancy and the Nature Preserves Commission called the Volunteer Stewardship Network. The Network consists of 400 volunteers that manage 88 nature preserves in the six-county Chicago area. This diverse group works outdoors year round monitoring and maintaining the wildlife in the preserves, educating their communities about the importance of natural areas and lobbying local government for protection of local natural areas.

Hazardous Waste Cleanup in Chicago Warehouse

Cleanup operations are underway inside a warehouse located at 5800 South Throop Street in Chicago to remove abandoned hazardous waste. More than 700 55-gallon drums, containing assorted hazardous materials, are packed inside the warehouse which is located in a residential neighborhood across the street from the Arnold W. Bontemps elementary school. The cleanup is expected to last several months and will cost approximately $350,000.

The Illinois Environmental Protection Agency sealed the building on June 24, 1987 after the Chicago Department of Environmental Control discovered the unsecured warehouse full of abandoned waste. Since the discovery, several agencies have become involved with the cleanup including: the Chicago Board of Education, the Metropolitan Sanitary District, the Chicago Department of Public Health and the Chicago Department of Environmental Control.

Unravelling the Mystery of Illinois Savanna

Savanna, grasslands with scattered trees, once covered northeastern Illinois and much of the Midwest. But the names Downers Grove, Elk Grove and Long Grove may be all that is left of this native Illinois landscape. If some savanna still exists today, we may not know it because researchers are just now learning what it looks like

Prairie volunteers have found that savanna is not just prairie with interspersed trees, but a distinctive ecosystem. The mysterious savanna is being pieced together with the help of the notes of Doctor Mead from Hancock County, written in 1846. He left a description of savanna that can now be deciphered. His findings have confirmed the description recently developed by ecologists.

Little by little a vision of native northeastern Illinois is becoming clear. Through intensive experimental management work, the rarest of our grassland types may be brought back from oblivion.

Funding Available to Research Illinois Coal

More than $2 million is available this year for research on the scientific properties of Illinois' high sulfur coal. Money for the research program, now in its seventh year, is provided by the Illinois Department of Energy and Natural Resources through its Office of Coal Development and Marketing (OCDM).

Research categories include coal cleaning, combustion, fuels and chemicals derived from coal, coal characterization, related desulfurization studies and gas cleanup.

John Mead, OCDM director, said increasing the base knowledge of coal stimulates process and engineering developments that are based on research findings.

Last year, 27 research projects were funded through a similar allocation

Joint Environmental Investigation in Atlanta

Occidental Chemical Corporation in Atlanta, and the Illinois Environmental Protection Agency (IEPA) have reached an agreement on work to be conducted in an environmental investigation. From 1962 to 1977, the company (formerly known as Diamond Shamrock Corporation) owned and operated a pesticide and fertilizer plant in Atlanta where pesticides containing heptachlor, chlordane and aldrin were formulated.

Occidental has agreed to perform several tasks including (1) an investigation of soil, sediment, surface water, and groundwater at select locations throughout Atlanta to determine if they contain pesticides formulated at the plant from 1962 to 1977, breakdown products of these pesticides, and/or solvents which acted as carriers for the pesticides; (2) a determination of the nature and extent of contamination; (3) an assessment of the risk that detected contaminants may pose to the citizens in Atlanta and the environment and; (4) if needed, an evaluation of alternatives to minimize human exposure to excess levels of these substances found in the soil, water and sediment. The IEPA will oversee all work conducted by Occidental to verify that it meets strict criteria and that the data collected are valid.

In 1986, the IEPA conducted soil, bird, and garden produce sampling within a three-block radius of the former Diamond Shamrock facility in Atlanta. The results indicated the need for more sampling of certain substances to determine potential long-term risks. From information gathered thus far, these concentrations do not appear to present a significant risk for short-term exposure.

IEPA Launches Agency Recycling Program

The Illinois Environmental Protection Agency launched an in-house recycling program in February that encourages Agency employees to recycle waste which is generated at work and at home. A limited recycling program had been in place since the 1970's. Now IEPA recycles aluminum, newsprint, cardboard, computer paper and all types of office paper. The IEPA's goal is to recycle two-thirds of all waste paper. Eventually, the Agency hopes to include the collection of glass and plastic for recycling.

The Solid Waste Management Act, approved by Gov. Thompson in 1986, is intended to reduce reliance on land disposal and promote the development of disposal alternatives. Recycling is one such alternative and the market has developed over the past two years to the extent that recycling is both feasible and profitable.

Other state agencies and organizations are encouraged to adopt similar recycling programs. If organizations would like IEPA's assistance in establishing or expanding a recycling program they can contact the IEPA's Office of Public Information at (217) 782-5562.

The Soil Erosion Battle

Every year in Illinois 200 million tons of soil are lost from 32 million acres of rural land (any land outside of urban areas excluding bodies of water), according to the Illinois Department of Agriculture. That breaks down to about 6.3 tons of soil lost per acre each year. The numbers sound dismal. However, progress is made in soil conservation every year. Illinois is a leader in overall conservation tillage, and ranks number one in "no till" practices.

Natural Lands Not Enough to Save Native Wildlife: Look to Illinoisans for Help

Large parks and refuges are not working to preserve native birds and mammals in Illinois or throughout the United States, according to Dr. Larry Harris, University of Florida. "We are approaching a 'silent spring.'"

Harris said that 20 years ago there were 20,000 species of birds in the world. Only 9,000 species exist today. In Illinois, 23 nongame wildlife species are threatened with extinction while 58 species are endangered including the bald eagle, the great egret and the lake sturgeon whose numbers have seriously decreased. Harris pointed to the fragmentation of wildlife habitat as the reason large mammals and native migratory birds are on the decline.

"We need to develop wildlife easements to link isolated natural areas for migratory species." Harris advocates the development of streamside buffers, grass waterways and vegetated fencerows in agricultural areas. "These things are good for agriculture, too," he said.

Such protection takes money. State researchers look to Illinoisans to help wildlife by donating up to $10 of their state income tax return by checking line 11a on Illinois income tax forms. Money raised through the Nongame Wildlife Conservation Fund Checkoff is used to restore habitat and manage endangered species.

In 1987, Illinoisans contributed $199,000 to save wildlife through the program. Funds have been used in the past for more than 120 projects including such diverse subjects as wetland and grassland restoration, bluebird re-establishment, Bald Eagle Appreciation Days and the re-establishment of peregrine falcons in Chicago.

In addition, individual donations may be made to the Fund by sending checks to the Nongame Wildlife Conservation Fund, Ill. Dept. of Conservation, Division of Natural Heritage, 600 N. Grand Ave. West, Suite 4, Springfield, IL 62706.

Listening for the Song of the Frog

For several years the Illinois Department of Conservation (DOC) has conducted a survey of frogs and toads by having volunteers make a circuit of stops on spring evenings to listen for the familiar croaks sounded by males during the mating season.

"A decline in frog populations is a first-line warning of environmental degradation, like pesticide runoff in rural streams," according to Carl Becker, DOC's Natural Heritage Division chief. "By paying attention to frogs and toads we can tell when our environment may become compromised."

According to Becker, frog and toad calls are very distinctive. The cricket frog is only 1½ inches as an adult but has one of the loudest calls of the 20 or so species in Illinois.

The bull frog has a very long, slow croak, and the spring peeper of northern Illinois sounds like its name. One frog is even called the chorus frog. It occurs only in the Midwest and is a threatened species in Illinois.

In addition, some frogs have very fancy markings like the leopard frog. The green tree frog is a beautiful color. It is distinguished by toes that look like suction cups used to grip tree branches.

Toads are a little different from frogs in their habitat requirements. They can live on land and are often found in gardens, but like frogs, they need to deposit their eggs in a watery environment.

Frog surveys started March 15 and end in June.

Eagle Count Soars to 1016

A midwinter survey counted 1016 bald eagles in Illinos, according to the Illinois Department of Conservation. The bird count included 659 adult bald eagles, 342 immature birds and 15 eagles of unknown age. One adult golden eagle was seen at Crab Orchard National Wildlife Refuge in southern Illinois.

The survey provides a good estimate of the number of bald eagles wintering in the state. The same sites are checked every year and aerial checks are made by the Illinois Natural History Survey.

Bald eagles are a state and federally endangered species due primarily to habitat loss and past use of pesticides. However, since the ban against DDT use in 1972, eagle populations have been recovering and the birds winter in large numbers in Illinois every year.

The majority of eagles, or 54 percent, were observed along the Mississippi River. The survey shows how important the river is to eagles. The unfrozen waters at locks and dams near Keokuk and Rock Island provide feeding grounds all winter.

The greatest concentration of eagles was in an area north of the Quad Cities and the Chautauqua National Wildlife Refuge. In addition, 23 bald eagles were counted at Crab Orchard National Wildlife Refuge, 24 on the Ohio River at Pulaski County, and 15 on the downstream portion of the Kaskaskia River. Another 24 eagles were counted on refuges, lakes and reservoirs in the state.

Building Illinois' Mussel

A proposal to establish seven sanctuaries along the Mississippi River for certain species of commercially harvested freshwater mussel populations in 1982 and 1985 prompted a study by the Illinois Natural History Survey, which showed that 34 percent of all the mussels collected in 1983 and 12 percent of those collected in 1985 died without a known cause and that sanctuaries are needed for further study.

The sanctuary beds could serve as a source of seed populations for the commercially harvested mussel populations, Carl Becker, Department of Conservation Natural Heritage Division chief, said. "To protect both the health of our aquatic environments and our commercial musseling industry, it is essential to determine the cause of major mussel losses."

Becker added that a healthy mussel population is often indicative of the general health of other aquatic species, as well as commercial fish species, and the quality of our rivers and streams.

Since the 1950's freshwater mussels have been harvested from the Mississippi drainage for use in the cultured pearl industry in Japan. Prices for the shells climbed in 1984 stimulating exceptionally heavy harvesting with commercial shellers coming from as far away as Texas and Oklahoma, according to study findings.

Also, the discovery of pearls of exceptional value in Wisconsin and near Grafton, Illinois, caused many shellers to open every mussel instead of returning undersized individuals back to the rivers. These events may not have been directly responsible for the die-offs, said Becker, but may have indirectly weakened the population to withstand other impacts.

Mussel sanctuaries are proposed along the Mississippi at the following locations: above Lock and Dam 12; at Sylvan Slough from the I-74 highway bridge west to the lower tip of Arsenal Island; an area north of New Boston boat launching ramp; at Pontoosuc Bay; an area at the mouth of the Des Moines River to the U.S. Route 136 bridge; upstream from Hannibal, Missouri; and near Hasting's Landing and West Point Landing boat ramp.

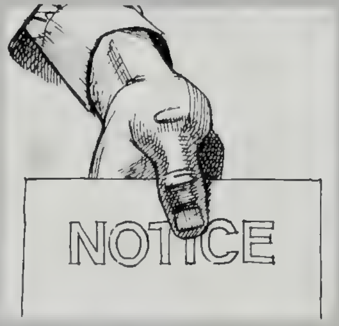
Notice Sent to Public Water Supply Customers

Every public water supply customer can expect to receive notice of the dangers posed by lead in drinking water. The Safe Drinking Water Act amendments of 1986 require every public water supply in the United States to distribute such notification by June 19, 1988, whether or not the supply has ever exceeded the federal lead standard, currently set at 50 parts per billion (ppb).

Suppliers may notify customers by one of two methods. Hand delivered or mailed notices are to be delivered once; newspaper notices must be published for three consecutive months, starting no later than June 19.

No public water supply in Illinois distributes water which exceeds the lead standards when it leaves the treatment plant, according to Richard J. Carlson, director of the Illinois Environmental Protection Agency. Lead contamination can occur when water stands for a period of time in plumbing systems which contain lead, Carlson said. The primary preventive measure is to allow water to run for a short time to flush the plumbing system, if water has not been run for several hours (overnight, on weekends or during holiday periods).

Lead is found in food, dust and soil, as well as drinking water, and can be inhaled from the air. When ingested it can cause physical damage. Sensitivity levels vary. Persons concerned about lead levels in their drinking water can have samples tested by qualified labs. Fees range from $20 to $100. To help users understand the problems, the IEPA has prepared a booklet, "Illinois Drinking Water and Lead", which is available from the IEPA, 2200 Churchill Rd, P.O. Box 19276, Springfield, IL 62794-9276. The booklet also lists labs which have been certified as competent to test for lead.



Recycling Directories Available

The latest information on recycling markets is available in two directories recently published by the Illinois Department of Energy and Natural Resources (ENR).

The Directory of Illinois Recycling Centers is designed to help consumers locate recycling collection centers. Both a Chicago area edition and a down-state edition are available. The second publication, The Illinois Recycled Materials Market Directory, is a guide for recyclers who want information on companies that buy recyclables.

Both directories include markets for aluminum and steel cans, glass, motor oil, paper and plastic. Businesses accepting scrap metal and tires are also included in the directory for consumers.

Recycling can conserve a lot of landfill space since about 50 percent of municipal household trash has the potential to be recycled.

Call ENR's Information Clearinghouse at 1-800-252-8955 to receive one of the free directories.

TRANSITIONS

IEPA Director Resigns

Governor James R. Thompson has announced the resignation of Dr. Richard J. Carlson, director of the Illinois Environmental Protection Agency (IEPA). Carlson, who had the longest tenure of any IEPA director, resigned to form an environmental consulting firm based in Chicago. The resignation was effective May 3.

"Rich's leadership helped enact a strong groundwater protection plan and establish the Administration's Clean Illinois program, a very ambitious abandoned hazardous waste cleanup program," Governor Thompson said. "And his tenure also will be remembered for improved enforcement of solid and hazardous waste regulations."

Dr. Richard J. Carlson

Prior to his appointment as IEPA director, Carlson served as the Governor's advisor for Environment and Natural Resources, and Government Reorganization from 1977 to 1981.

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Send this application to the Society for the Illinois Scientific Surveys, 1525 S. 6th St., Suite B, Springfield, IL 62703. Inquiries by telephone will be handled at (217) 522-2033.

Understanding Our Natural Heritage

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THE NATURE OF ILLINOIS

Fall 1988

NATURAL HISTORY SURVEY

OCT 1 8 1988

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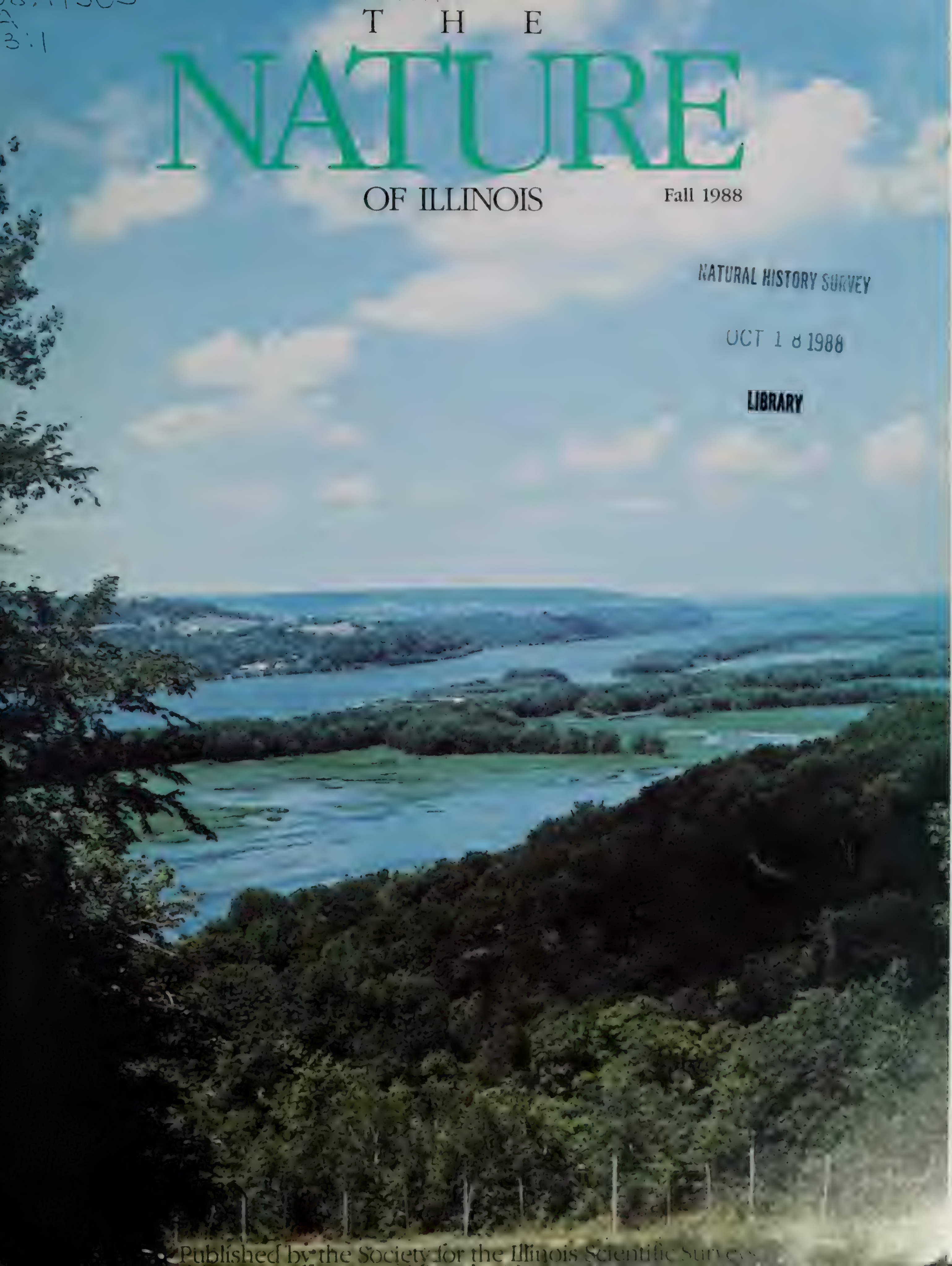

Published by the Society for the Illinois Scientific Surveys

The Society Page

You'll notice some new things in this issue of **The Nature of Illinois.** We decided to celebrate fall with more color — 16 pages of it. We've added a new feature called "The Art of Nature" to profile Illinois artists. We have expanded our Natural Resources Digest to include news briefs ranging from Amazonian birds to European bees. And we are reaching more and more of you — now 10,000 — with the message that Illinois is a state of amazing natural diversity.

Galena in northwestern Illinois is one of those hilly areas that seems such an anomaly to those of us used to thinking of Illinois as flat, flatter and flattest. Follow this fascinating city as Jim Krohe chronicles its rise from a lead-mining town, river port and home to Ulysses S. Grant through a century of decline to its resurgence as a center for tourism and recreation.

Science has its historical monuments too, and in Illinois one of them is the **Havana River Research Station,** built in 1894 and one of the oldest field laboratories in the country. We take you through a day in the life of the station and the scientists who work there.

The dog days of August and **the drought of 1988** may seem like ancient history to you by now, but in this article Survey scientists caution that the drought's effects are far from over.

As a printer, maps have long held a fascination for me. Map-making enters the computer era with the advent of the state's **Geographic Information System,** profiled in this issue.

There is art in nature, and in this issue we look at an Illinois artist who has found his **Paris on the prairie.**

Although I am a "dog" man myself, for cat-lovers we have included an article on **the domestic feline,** the animal who knows a thousand secrets and will tell none.

Finally, our thanks go to Director Jay Hedges and the Illinois Department of Commerce and Community Affairs for their help in presenting this new, improved version of our magazine

Enjoy a colorful fall!

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
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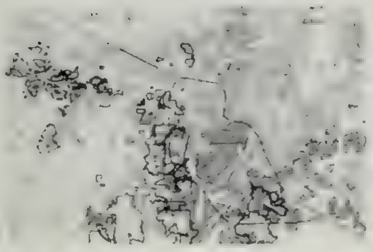
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Survey scientists bell the cat to determine its impact on wildlife.

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Galena, Illinois.

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Editorial Staff

Jane A. Bolin
Editor

Jane Christman
Assistant to the Editor

Ben Halpern
Photographer

ComUnigraph
Design and Production

The Society Offices

Correspondence about memberships, magazine deliveries, contributions and general information should be addressed to the Society for the Illinois Scientific Surveys, 319 W. Cook, Springfield, IL 62704.

The Society encourages readers to submit letters to the editor of **The Nature of Illinois** at the address above.

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by James Krohe Jr.

Galena, promises a tourism brochure, "isn't like the rest of Illinois." For once the brochures do not exaggerate. This restored Jo Daviess County town is a fascinating mix of 19th century architecture and 20th century recreation, the home of the nation's first mineral boom whose citizens mastered their own conjurors' trick and turned lead into bricks and tourist cash. Galena is also a textbook illustration of the opportunities and the risks of basing local economies on exploitable natural resources.

The Alchemy of Galena

The Lead Rush

Galena was founded in the 1820s on the banks of the Fever (later renamed Galena) River less than three miles from where that stream enters the Mississippi. Its real founding, however, may be said to have begun millions of years earlier when mineral-rich brines deposited lead and zinc sulfides in the fractures of Ordivician rocks. Lead sulfide — "Galena" to the Romans — is the ore from which the metal is smelted, and thousands of tons of it accumulated in cracks and crevices, some quite near the surface.

The Sauk, Winnebago, and Fox Indians all mined lead from deposits in the upper Mississippi Valley, using the malleable gray metal to make ornaments or trading it to the French. To most whites, lead was a work-a-day metal used in paints and food tins. But lead also was used to make musket ball and cannon shot, much of the lead for which had to be imported to the U.S. until 1822 for lack of indigenous supplies.

The discovery of mineable deposits of lead in the upper Mississippi excited not just get-rich-quick prospectors but federal authorities. Lead mining became one of the fledgling nation's first defense industries. While it may have lacked the romance of subsequent mining rushes in California and Alaska, the "lead rush" which began at Galena in the 1820s was just as frenzied. The town was the shipping and supply point for the Federal Landmine District which reached into Wisconsin and which at its peak may have contained as many as 10,000 men digging ore. In 1845, when production was at its peak, 53 million pounds of lead were shipped out of Galena, more than four-fifths of the entire U.S. output.

Mining at first required little more than a pick, some powder, and a mule. The easiest diggings were from the "float" deposits left in unconsolidated surface layers; some pastures around Galena are still pockmarked by such diggings. Deeper "flat and pitch" deposits had to be reached by shafts dug into bedrock for distances of up to 60 feet, which was as far as man could hoist ore buckets without the help of a steam engine. Eventually, even deeper veins of lead ore, and, later, zinc were tapped as mines and machines got bigger.

The ores at first seemed rich beyond exhaustion. "It seems not unlikely that these mines may supply the world," wrote one Galenan with the timeless optimism of the boom towner. But the deeper one had to dig for it, the more expensive Galena's lead became. Metals markets are notoriously unstable, and even in its robust early days Galena suffered slumps. The town's fortunes were usually revived by war (a lot of Confederate soldiers were buried with Galena lead in their bodies), with federal price incentives sparking a boomlet among independent operators as recently as World War II.

Lead was not the only valuable mineral mined in them thar hills. Those ancient cracks were also filled with sphalerite, the parent ore of zinc. "It was a nuisance to most miners until the Civil War," explains Daryl Watson of the Galena/Jo Daviess County Historical Society. A new processing technique made recovery of zinc profitable and a new

The 1857 Belvedere House

Jo Daviess County farm

boom was born. (Some old lead mine tailing piles were even re-mined for the zinc they contained.) "Sometime after the Civil War, the value of zinc mining in Galena exceeded that of lead for the first time," notes Walton. "By the late 1800s, more than 80 percent of the area's entire mine output was zinc."

The last modern mines such as the Eagle Pitcher and the Blackjack mine outside Galena did not close until the 1970s (At its peak, Watson estimates, the tailing pile at the Eagle Pitcher site would have qualified as the highest point in Illinois.) But metals had not anchored the local economy for decades. Price, not supply, caused mining's demise. "There is still ore in the ground up there," explains Jim Bradbury. Bradbury, now retired, worked in Galena in the 1950s for the Illinois Geological Survey, studying drilling records (a principal means of prospecting) and mapping the local rocks. "But there are no big ore bodies that anybody knows about."

Steamboat Trade

But Galena was never just a mining town. The miners arrived before the farmers and the sawyers and the cobblers, and for years all of the food and equipment needed to run the camps had to be shipped in. Mining miners was as profitable as mining lead, and those profits supplied capital for other, more durable enterprises. "Galena reached its apex as a commercial center in the 1850s," Watson says, a decade after lead production peaked. The town had a monopoly on upper Mississippi steamboat trade, and was a major port with St. Paul and St. Louis.

That trade floated on the river. The Galena in the heyday of the small upper-river steamers was at least 200 feet wide off the town's docks. The river eventually took its name from the town just as the town had taken its name from the ore, but the town took its location and its livelihood from the river. Galena sits as far up the Galena (and as close to the lead diggings) as steamers could dependably travel. "Galena was the doorway to the mining district," says local historian Dick Vincent. "If it wasn't for the river, Galena would be just like the other lead mining communities in the area."

Its merchants were quick to exploit the river's access to the Mississippi and thence to St. Louis and St. Paul. The town became the shipping and wholesaling center for the whole burgeoning region. The coming of the railroads in the 1850s, however, took cargo from the steamboats and eventually business from Galena, leading some locals, then and now, to blame Galena's subsequent long economic slumber on the railroads. But even if steamboating hadn't died, Galena's future as a river port would have been doubtful. The villain wasn't the steam locomotive but the ax.

In 1820, Jo Daviess County was nearly all trees. Only a handful of spots in all of Illinois had so much of their land in forest, and wood was the petroleum of the early 19th century. Steamboat boilers were fired with wood. So were the lead smelters. Galena's lead boom in fact depended as much on plentiful local supplies of wood as it depended on plentiful lead ore. "Even in the Indian period, tremendous numbers of trees were cut to run the smelters," explains Daryl Watson. "The early superintendent of the lead district prohibited the indiscriminate cutting of trees, ordering the best ones reserved for smelting. That suggests that even then there were not a lot of good trees left."

Terry Farmer — DCCA

Elevations of Galena

Farmers felled trees, too. Local agriculture expanded with population, so that the value of farm products produced in the area exceeded that of lead as early as 1850. The combined effects of smelting and farming on the forests were devastating. Old photos show whole hillsides so denuded that they resembled (in Watson's words) goat pastures in Greece.

The hillsides above the Galena, thus exposed, eroded badly. Even in 1839, local steamboat captains were warning that the Galena was silting up. The stream had to be dredged that year and again in 1856; by the Civil War it was already reduced to

what Watson calls "a pathetic little stream" which was more mud than water in summer. More dredging, even eventual construction of a lock and dam downstream, could not restore the river as a dependable navigable stream.

A river which didn't have room for a steamboat didn't have room for flood waters either. Flooding was common. When the Market House was built in 1846 on the alluvial terrace between Commerce and Water streets, the entire block was filled in and raised by nine feet, although even that proved to be not enough. The worst flood, in 1937, reached higher, and damage to low-lying buildings was substantial. Restoration of the town's historic buildings could not begin in earnest, in fact, until 1951, when the present system of levees and flood gates was installed.

Today the Galena River ambles between grassy banks, and boys sit fishing on the spot where steamboats used to churn. The only paddleboats on the river are canoes, rented by tourists for a jaunt downriver to the Mississippi.

Main Street — Galena, Illinois

"Quality Hill"

The commodious warehouses and other commercial structures which still line Galena's riverbank are reminders of the volume of goods which the river trade once brought to town, just as the hotels and mansions which grace the sides of "Quality Hill" testify to the wealth which moved through the pockets of its citizens. (Galena even owes its claims to its most famous son, Ulysses S. Grant, to trade: Grant found refuge from his failed early career in his family's Galena leather goods store in 1860 when the world still needed store clerks more than Civil War generals.)

Galena's architecture was as grand as its wealth could afford and as pretentious as the pride of its self-made men could imagine. Most of its buildings are stone or brick, the result of a ban on wood construction in 1850 which followed fires along its crowded docks. New buildings went up with each successive economic boom, and each era built in the fashion of its day. Log houses were succeeded by churches, mansions, schools, and public buildings in Greek Revival or Federal styles, which in turn were followed, in overlapping waves, by Italianate, Queen Anne, Second Empire, Gothic Revival, and Romanesque Revival concoctions. Galena's largest mansion, the 1857 Belvedere, has been likened to a Tuscan villa and a wedding cake but probably most deserves the label "Steamboat Gothic." Built for a local steamboat magnate, it looks like a landlocked river palace.

The long economic dormancy into which the town slipped in the century after the Civil War meant that most of its old buildings were not remodeled or replaced but survived remarkably intact. The result was an outdoor architecture museum, a ghost town of uncharacteristic substance. What had been useless became unique; in 1969, no less than 85 percent of the old town was deemed worthy of listing on the Department of Interior's National Register of Historic Places.

Today dozens of Galena's period buildings have been restored as monuments to its own past. The Customs House which once oversaw the steamboat trade is now the local post office. The old Market House was restored by the State of Illinois as a museum. The former Illinois Center Depot now houses a tourist center. Many houses have been converted to bed & breakfast facilities and guest houses, and shops which once peddled picks and oil lamps now house antique shops, craft studios, and restaurants. And — perhaps most symbolic of Galena's revival as a tourist center — the 1853 DeSoto House hotel on Main Street is now a hotel again after years of hosting such varied tenants as the Illinois Geological Survey field office.

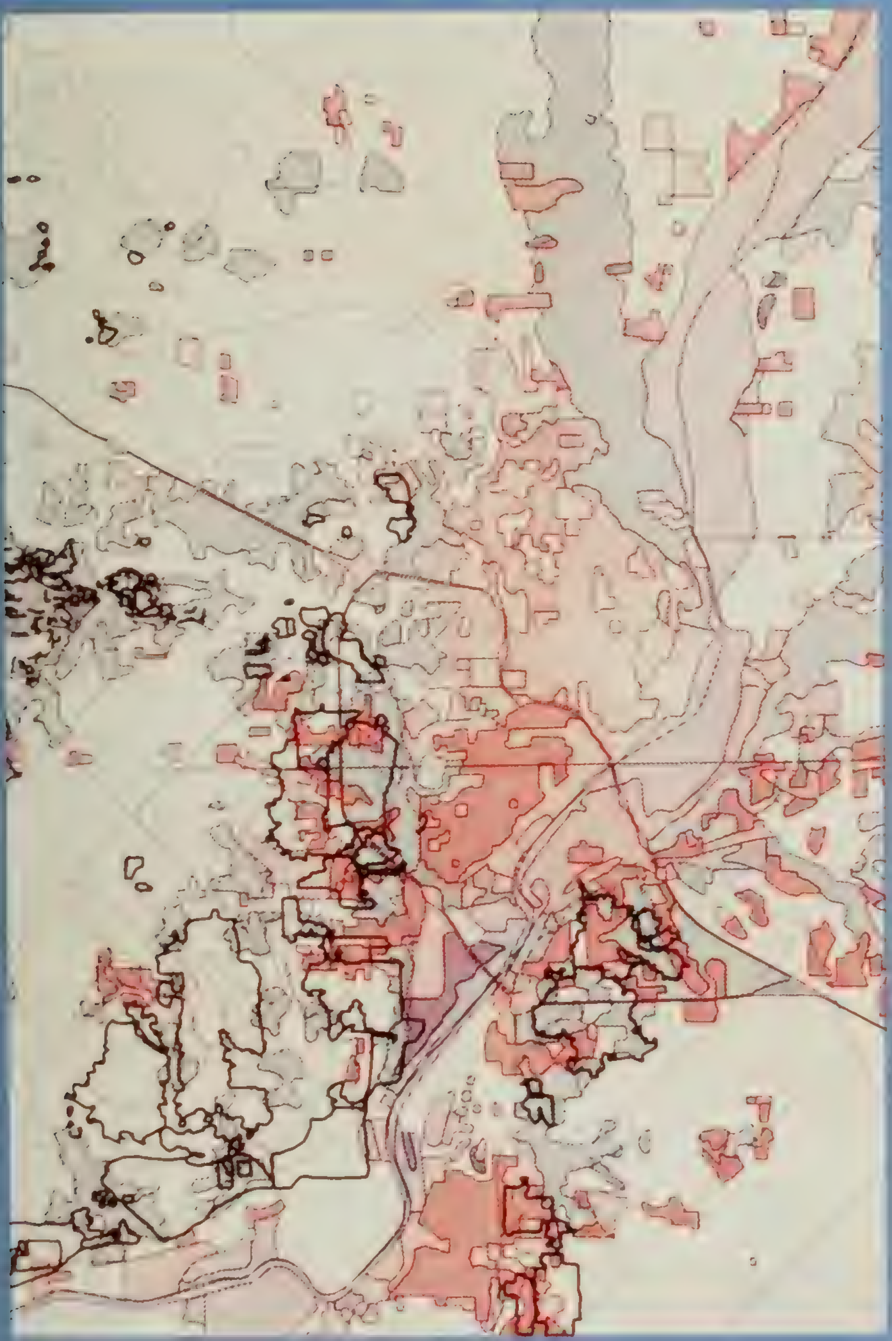
Boom Town

Galena's historic buildings are to a large extent both the means and the ends of its career as a tourist attraction. But those buildings owe much of their charm to their setting. Today's tourism boom, like the mining and shipping booms before it, depends on Galenans' ability to exploit the region's unique natural resources of hills, forest, and water. Galena lies at the southernmost tip of the Wisconsin Driftless Section, a region whose Ordivician limestones and dolomites have been incised by streams into deep valleys. Successive glaciation modified, indeed obliterated the early landscape of much of the rest of Illinois, but the ice never plowed across Galena. The result is a distinctly un-Illinoisan vista of rocky prominence separated by pastoral valleys. Illinois' highest point is nearby; so are some of its most beautiful.

The crumpled-up terrain around Galena was an impediment to progress in horse and wagon days but today it has helped turn Galena into a year-round vacation and resort spot. Illinois's sole downhill ski run is near Galena. The nearby Mississippi offers hunting, fishing, and boating in all seasons; its forested hillsides offer hiking, cross-country skiing, and camping. Galena has become a regional economic center again, this time serving not outlying mines and farms but the marinas, ski lodges, riding stables, campsites, and golf courses which dot the countryside. Galena and environs are seeing another spurt of building, this time in time-share condos and summer houses, and it is again doing trade with faraway places: Stop at any local gas station in summer and you will see cars bearing license plates from Texas or Virginia as well as Illinois, Iowa, and Wisconsin.

Galena, in short, is a boom town again. On certain weekends today its streets are as crowded as they must have been 150 years ago, and local tourism officials are wondering aloud whether booked-up hotels and traffic jams may not be too much of a good thing. Space and unencumbered views can be ruined as quickly as metal ores and forests and rivers. Galena's past is not just a commodity, but a useful warning.

Putting Illinois On The Map



Portion Of A Map Created For A Peoria, Illinois Civic Organization

The map shows that the area immediately south and west of Peoria contains minable coal deposits and areas of abandoned underground mines.

General Key:

Red: Urban
Green: Forests
Blue: Water or wetlands
Black: Barren or mines
Stripes: Coal deposits (minable)
Black lines: Underground mines
Dashed lines: Surface mines
Red line: Interstate 74

Large blue area running from top to bottom is the Illinois River

Central Illinois is well known for its corn and soybean crops. It may soon be known as the center of a remarkable computer-driven renaissance in map-making.

The three Illinois Scientific Surveys, with the aid of a computer system called the Geographic Information System (GIS), are creating multi-color, multi-dimensional natural resource maps that would make Amerigo Vespucci hang his head in shame. Art and technology have come together to reprove the old axiom that a picture is worth a thousand words.

Physically housed in the Natural Resources Building in Champaign, the system had its genesis in a federally-mandated program that required states to develop scientific data bases on resources particularly vulnerable to coal mining. From there Illinois' GIS expanded to a statewide natural resources library, with information on everything from woodlands to geological structures to archaeological sites

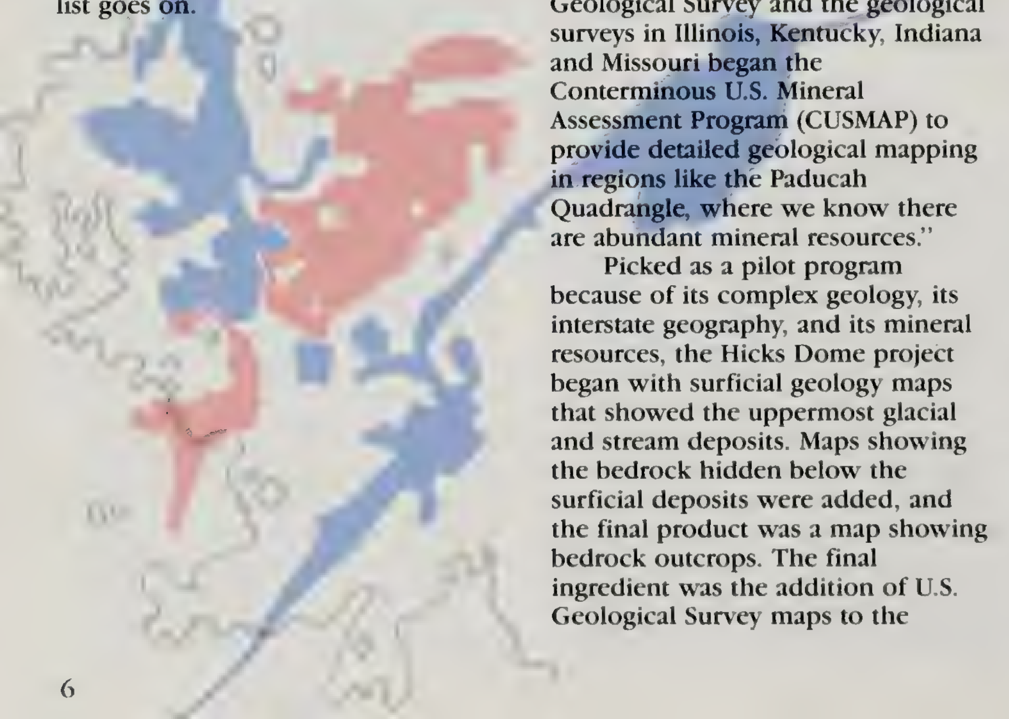
The system consists of map processing software that runs on a network of four PRIME computers. Terminals located in Springfield, Champaign and Marion allow the GIS to be used by the Surveys, other divisions of the Illinois Department of Energy and Natural Resources (DENR), the Illinois Department of Conservation, the Illinois Department of Mines and Minerals, and the Illinois Department of Commerce and Community Affairs.

A few years ago GIS was a single PRIME computer with only two megabytes (two million bytes) of main memory and 300 megabytes of disk storage. The system was soon overloaded as the state poured in vast amounts of natural resources data, necessitating acquisition of an additional PRIME computer with 32 megabytes of main memory and 10 gigabytes (10 billion bytes) of information.

The Flow of Information

The GIS standardizes cartographic information by converting it into a digital representation of that data. A map is mounted on an electronic drafting board, where it is digitized by a computer "mouse" that is used to enter map features. GIS users also purchase previously digitized information. To that layer of information the GIS uses files that add intelligence to these digitized map lines, associating them with real-world features, like a geologic fault.

The ultimate product is a variety of maps that show the presence of aquifers, soil types, streams, woodlands, vegetation types, and the list goes on.



Best of all the GIS is able to take one map and overlay it with another. If a company wants to site an industrial facility in a specific county, the location of the proposed facility and associated features such as sewer lines can be compared to locations of roads, electric lines, geological faults, water wells and many other features. In essence the GIS manipulates data by putting one map on top of another and analyzing the results.

Mapping Minerals

One area that is being extensively mapped on GIS is Hicks Dome, located in Hardin County in southern Illinois. About 250 million years ago, when Illinois was literally shaking with earthquakes, violent gaseous explosions pushed up sedimentary rock layers laid horizontally on the ocean bed into a giant dome. That was Hicks Dome, once as high as 2,000 feet, but now eroded to a shadow of its former self. Seen by air, it is an obvious circular structure ringed with faults that covers a 12-mile by 12-mile area.

It is part of a larger geological area known as the Paducah Quadrangle, covering one degree of latitude and two degrees of longitude, cutting through Illinois, bits of Indiana and Kentucky and a goodly part of Missouri.

"It is a vast area with complex geological structures and abundant mineral resources. It's a natural for GIS mapping," according to Rob Krumm of the Illinois Geological Survey. "Two years ago the U.S. Geological Survey and the geological surveys in Illinois, Kentucky, Indiana and Missouri began the Conterminous U.S. Mineral Assessment Program (CUSMAP) to provide detailed geological mapping in regions like the Paducah Quadrangle, where we know there are abundant mineral resources."

Picked as a pilot program because of its complex geology, its interstate geography, and its mineral resources, the Hicks Dome project began with surficial geology maps that showed the uppermost glacial and stream deposits. Maps showing the bedrock hidden below the surficial deposits were added, and the final product was a map showing bedrock outcrops. The final ingredient was the addition of U.S. Geological Survey maps to the outcrop map showing power lines, railroads and other reference points. Any field observer can now go to the area and, using the reference points provided by the GIS map, can locate and identify the type of bedrock outcrops in the area.

"We are well on our way to completing bedrock mapping for the entire CUSMAP area. More importantly, we were able to get GIS mapping standards for CUSMAP. We proved that it is possible to enter data from different sources and produce usable, valuable maps. This will be enormously helpful as we assess the mineral resources of Hicks Dome and the Paducah Quadrangle," explains Robert Pool of the IGS. "By 1990 we should have substantial information on the area's mineral resources."

Customized Mapping

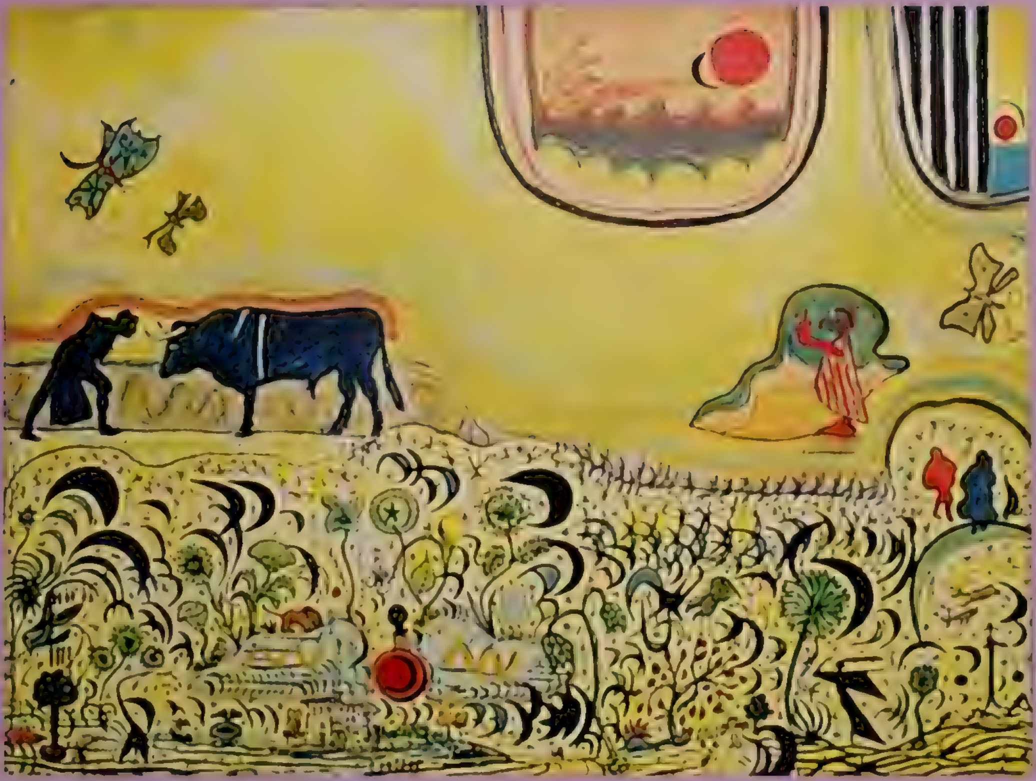
The Geographic Information System is just as useful when the lead time for complex natural resource data is short.

Colin Treworgy of the Geological Survey reports on a three-day turn-around for a Peoria project: "Tri-County Tomorrow, an economic planning group for Peoria, Woodford and Tazewell counties, asked us to investigate mineral resources in that area, especially coal. In less than a week, we were able to give them a GIS-made map showing current land uses — residential, commercial, industrial, forestlands, agricultural lands and wetlands — and coal resources attractive for mining."

"Our maps also provided them with some information they hadn't asked for, but was quite dramatic. The Peoria metropolitan area is expanding in some areas over abandoned underground mines, and the potential of mine subsidence is another important issue for this kind of group to consider."

"What we proved is that we can customize maps in very short periods of time for groups of people with very specific needs — all in a very graphic, understandable way."

Rob Krumm and Robert Pool are Associate Geologists/GIS Specialists with the Computer Research and Services Section of the Illinois Geological Survey. A Geologist with the Coal Section of the Survey, Colin Treworgy's principal areas of research are coal resources and coal mining.



Bruegel's Dancing Couple

Illinois State Museum

Paris ON THE Prairie

by Lynda K. Martin

The following is the first in a continuing series of articles profiling Illinois artists.

Early in his 60th year, prompted by a dream, Maurice Sullins began to paint. Upon awakening from the dream, Maurice, in his haste to start his new life as an artist, began drawing on whatever pieces of paper he could find around the house. When he ran out of paper, he cut apart record album covers and drew on the blank inside surfaces. Within a few weeks he had bought acrylic paint and was applying it to old mirrors, plywood panels, and masonite — scrap materials that were stored in his garage. From that time in 1970 until his wife Mary died in 1986, Maurice painted continuously and obsessively, producing over 1,200 paintings in 16 years.

There is little in this Ilinois artist's background that would indicate such an extraordinary turn of events. The third child in a family with seven children, Maurice was born in 1910 in Medora, Illinois, about 40 miles north of St. Louis. His father was a minister and was frequently required to move his family from one small town in Illinois to another. Maurice retains vivid memories of living in places such as Elkhart, Sadorus and Galesburg during the early 1900s.

In 1928 Maurice enrolled at the University of Illinois in Champaign and was awarded a B.S. in Geography in 1934. He also married in 1934, and in 1940 he and his wife Mary moved to Joliet, Illinois, where he still resides. Never employed in his field of study, probably because of the Depression, he worked at various jobs, including one as a foreman at the Fisher Body plant in Willow Springs and another waxing and detailing airplanes at the Joliet Municipal Airport.

One of the first to learn of Maurice's work was Timothy O'Keefe, himself a sculptor and eventually Maurice's agent. Maurice claims that he didn't do any artwork prior to his 60th birthday, a claim verified by his older brother. He did confide in O'Keefe that he had considered becoming an artist as a young man, but was deterred by the poverty most artists endure.

Maurice's art takes place primarily in his head, and the physical, material expression of it is secondary. While still employed at the Joliet Airport, Maurice would compose a painting in his mind during the day, refining it until it was complete. After working 10 to 12 hours, he would rush home and paint until one or two a.m. in order to record his painting on canvas. He would then sleep a few hours and get up to paint another hour or so before going off to his job where he would mentally compose yet another painting.

When he began painting in 1970, his work was somewhat primitive and clumsy, but always exuberant, carefully composed and richly colored. Without ever attending an art class, he progressed rapidly, learning how to handle his paint to best effect while trying out various techniques and styles in quick succession.

With no formal training in art, Maurice began painting without the structure and restrictions imposed by academic art programs. Over the years he had built his own philosophical framework, made his own rules, and developed very strict ideas about what is right and acceptable in the practice of art. He scorns the palette, preliminary drawings, live models, and other tools and techniques associated with painters. He paints in his living room with his canvas lying flat on two small tables. Maurice usually begins a painting by "floating on" a wash which he calls "clouds." "Floating on clouds," he explains, "is the nearest you can get to the Universe and how it is."

Maurice's images were applied over the wash with a brush or directly from the tube. He has terms for his various methods of applying paint and for different types of lines. His "Naughty Line" is a horizontal line representative of Mother Earth that forms the lower back and buttocks of a female figure. A wavy line applied directly from the tube is a "Master Stroke." A "Grand Stroke" is a horizontal line made in one sweep, and a "Grand Sweep" is a horizontal line that goes off the canvas and "into eternity." According to Maurice, "The grandeur and glory of the sky has never been revealed on canvas before because no artist had a Master Stroke, and if you don't have a Master Stroke you can't have a Grand Stroke, if you don't have a Master Stroke and a Grand Stroke you can't have a Grand Sweep."

A voracious reader who can expound on any subject at a moment's notice, his home and garage are filled with books, magazines and encyclopedias which he calls the "threads of life" because all the knowledge contained in them "ties together." He likes to point out that "everything in the world, everything in the universe everywhere, *everything* ties together."

When he began painting, Maurice read everything he could find relating to art and artists. As he became aware of the elements of art such as shape, form and positive and negative space, he saw everything in life in terms of these elements. In reference to this he will often state that "art is total living."

He educated himself about well-known artists by reading and by studying photographs of their work — O'Keefe calls him a "walking art encyclopedia." While he has never copied directly from others, images appropriated from artists such as Calder, Picasso, Rodin, Moore, Chagall and Matisse appear in his work along with his own set of personal symbols. It is his way of "paying tribute" to them and continuing their work.

Some of Maurice's personal symbols are largely confined to one series of paintings, while others appear frequently throughout his work. For instance, of the 60 paintings in the current exhibition, "The Dapper Frenchman", Maurice's alterego who is often accompanied by "His Dog", can be found in 13 paintings. In each painting the artist combines and juxtaposes both his personal and borrowed images in unexpected ways to relate a story, and each canvas is a continuation in the narrative pathway that is evident throughout his work.

One of Maurice's favorite pastimes is reading the dictionary, and he delights in playing with words. *Mr. Eiffel Tower and His Wife the Former Arc d'Triomphe, Miss Chicago Sails into Summer in a Royal Blue Strapless Maillot,* and *Personage Before The Moon* are among the titles he has assigned to his work.

The artist uses the name "Maurice LeGrand LeSueur Sullins" in order, he says, "to honor" his French heritage, LeSueur from his grandmother and LeGrand from his mother, Jennie. Although quite a number of his paintings are based on scenes from the French countryside and well-known landmarks of Paris such as the Eiffel Tower and the Arc d'Triomphe, Maurice has never travelled to France — his images of that country having been found in books and magazines. Maurice feels that it is not necessary for him to actually travel to a location in order to depict it accurately, because, according to him, everything in the Universe is connected and "goes on endlessly."

Like most outsider artists, Maurice paints for his own satisfaction and, until recently, was extremely reluctant to sell or even show his work. Except for the occasional painting sold to buy more art supplies or those lost or misplaced, his entire body of work was in his possession until 1987.

Maurice stopped painting in 1986 after the death of his wife Mary. After a period of eight months in seclusion, he seemed to come to grips with his own mortality and decided that it was time for him to show and sell his work. Devoted to his family, he says his primary motivation for this change of heart is his desire to provide a "legacy" for his grandchildren.

Although he occasionally mentions an idea for a new painting, Maurice seems reluctant to resume his work. O'Keefe believes that "Maurice is a true painter, and that's what he should be doing. It would be the best thing for him if he started painting again." O'Keefe has supplied him with a new box of canvases and fresh tubes of paint, but it remains to be seen whether Maurice will add to his already impressive body of work.

Previously exhibited at the Illinois State Museum in Springfield and at the Gaylord Building in Lockport, the Maurice Sullins exhibition can be seen from September 19 - November 10, 1988 at the State of Illinois Art Gallery in Chicago and thereafter travelling around the state. For more details, contact the Illinois State Museum.

Lynda K. Martin is Assistant Curator for Fine Arts at the Illinois State Museum.

Natural
RESOURCES DIGEST

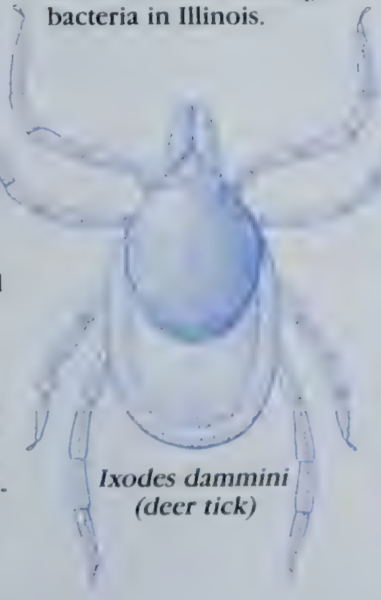
BIORHYTHMS

New Tick Brings New Disease To Illinois

While inspecting some deer last November a Natural History Survey entomologist and a doctor from the University of Illinois Veterinary Medicine College discovered a new tick previously unknown to Illinois. This new tick, or deer tick, is the carrier of a chronic, sometimes debilitating illness called Lyme disease (the number one tickborne disease in the United States). Symptoms include a rash, acute headache, chronic arthritic and joint pain, and neurological impairment, and are often misdiagnosed as rheumatoid arthritis.

Since the disease is so new (the first case occurred in Lyme, Connecticut in 1975) there is no vaccine. The best way to protect yourself against the disease is to avoid forests or wooded areas which the ticks inhabit, especially in the summer when they're abundant, and to avoid contact with animals they infect, such as deer, dogs, horses, mice, and other rodents. If you must enter the ticks' habitats, wear light-colored, long clothing (so you can see if the ticks attach to you), use insect repellants and carefully check your body for ticks after departing the area. Remove any ticks with tweezers and drop in rubbing alcohol to kill.

A group of scientists from the Natural History Survey and the University of Illinois College of Veterinary Medicine are trying to determine the distribution of the deer tick and the disease-causing bacteria in Illinois.



Ixodes dammini (deer tick)

Bugs Fighting Bugs

The use of foreign pathogens (diseases) to control insect populations has been an unresolved issue for several years. But recently two Natural History Survey scientists, Drs. J.V. Maddox and M.R. Jeffords, received an experimental permit from the U.S. Environmental Protection Agency to use foreign pathogens to try to control gypsy moth populations in Maryland.

Jeffords said that the gypsy moths have multiplied rapidly in the United States since they emigrated from Europe and left their natural enemies and diseases there. Doctors Maddox and Jeffords went to Europe to find the diseases which help control the moths and bring them to the U.S. to introduce them into select moth communities.

This is the first instance where the U.S. EPA has allowed foreign insect pathogens to be tested for insect control. The experiment can have great implications for future biological control efforts in the U.S.

Wintering In The Tropics

About 60 species of Illinois' birds winter in the Amazon Basin. Each year they join around 1,000 other species of birds that live in that area, considered the world's most abundant area of birds.

In order to study the birds' habitats and recommend ways to design nature preserves to help the species and their habitats survive, Dr. Scott Robinson, a Wildlife Ecologist with the Illinois Natural History Survey, received a grant from the National Science Foundation to live in the Amazon Basin and study the numerous species of birds that live there.

S. Robinson

Cocha Cashu Biological Station

Robinson says one of the major findings of the study is that most of the birds are very rare and have low population densiti which emphasizes the need to preserve large sections of their habitats to keep their populations viable. Since the grant period ends this year, Robinson will now finish analyzing the data and then write reports to the Peruvian government recommending conservation strategies for the habitats and birds.

This study wasn't your average scientific laboratory experiment. It required Robinson and other scientists to live in the jungle for months on end, with little contact with civilization. At times they encountered wild, uncontacted Indian tribes (one of which stole Robinson's laundry), and often ran head on into pumas and jaguars. How did he handle that? "Just stand there and don't move," says Robinson.

Catfish following suturing. Note antenna trailing from tail fin.

Save The Catfish

Catfish are important commercial and sport fish in Illinois, but their habitats have been adversely affected by erosion, weather, and river traffic. In order to ensure that the species' habitats are protected, and therefore help protect the species' existence, Natural History Survey Aquatic Biologist Dr. Richard Sparks is using a grant from the Illinois Department of Conservation to study what areas of the river catfish prefer during their lifecycle and if barge traffic affects them.

To do this Sparks tracked about 75 catfish over two years, with radio transmitters which were surgically implanted in the fish. He found that catfish prefer the side channels and back lakes of Illinois rivers, but have been forced into the rivers' main channels because the side areas are diminishing due to increased mud and sludge residue and decreased water levels from the drought. But in the main channels, the catfish are susceptible to the river traffic which can kill or stun them and make them easy prey for the vulture-like gulls that follow boats to feed on the fish.

Sparks says he will recommend that the side channels and back waters be dredged and restored to protect the catfish which account for 40 percent of total sport fishing demand and 16 percent of the commercial fish harvest in Illinois.

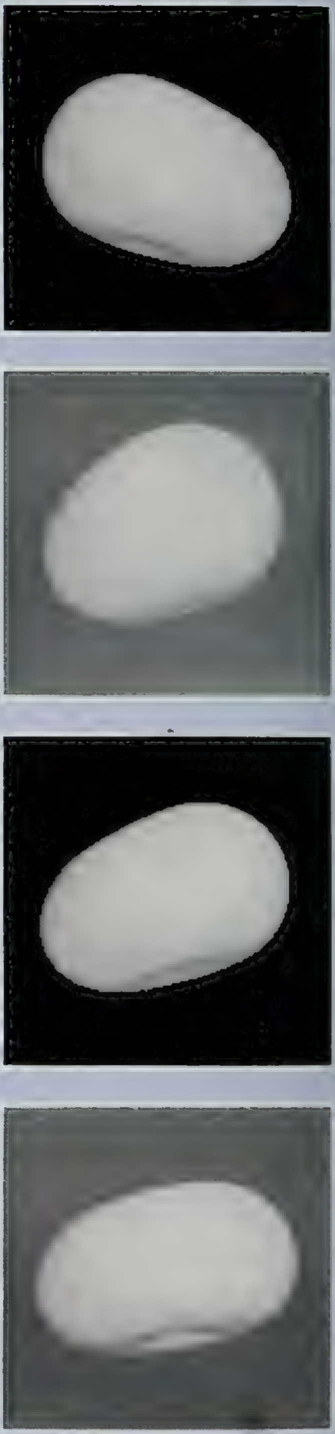
CURRENTS

Raindrop Dribblings

Who would suspect that the shape of a raindrop could affect our weather forecasts? With a grant from the National Science Foundation, Illinois Water Survey scientists are researching the vibrations and shapes of raindrops because weather radar systems base their radar pictures on the shapes of drops in clouds. The shape the systems are currently basing their picture on may not be correct.

Raindrops are not teardrop shaped (thin on top and wide on the bottom). Instead scientists believe they are more hamburger shaped (flat on bottom and rounded on top). The Survey scientists have built a raindrop generator in the stairwell of a seven-story building that will photograph drops as they fall and bounce off one another.

This data will aid their CHILL radar weather system, a national facility and one of the most advanced weather radar systems in the world, and will be used to better interpret what weather radars predict. In turn, understanding the true shapes of raindrops will help improve weather radar's detection of storm systems and may improve overall weather predictability.



A computer-generated oscillation sequence for a 5mm diameter raindrop.

The Great Lakes' Shoreline Seesaw

Researchers have learned that record low levels in Lake Michigan during the mid-1960s may be the primary reason for the $3 million in lakefront damage sustained during 1987's high water levels and severe winter storms. This conclusion is from a two-part study of the effects on the Illinois shoreline from extremes in Lake Michigan water levels. The project, funded by the U.S. Environmental Protection Agency, will provide a basis for assessing effects of altered lake levels caused by future climatic change.

Stanley Changnon of the Water Survey conducted a part of the study that evaluated the effects of record low lake levels on the Illinois shoreline during 1964-65. Changnon used this information to estimate the potential consequences of lower lake levels that might be caused by a drastic change to a drier climate.

Low lake levels in the sixties were followed by periods of extremely high lake levels, first in the early 1970s and then in the mid-1980s; a sequence that has produced many of the problems. During the period of record low levels, buildings and facilities were constructed in or near the new beach areas. When the water levels rose, these structures suffered considerable wave damage. Many of the seawall structures built by Chicago were exposed when the water levels fell and dry rot set in.

Weather Station Becomes Centenarian

On the clear morning of August 17, 1888 an observer read weather instruments and logged the first entries into the record book at a new weather station on the University of Illinois campus — the site of the new Agricultural Experiment Station. A 72 degree temperature and 91 percent humidity were recorded at 7 a.m. at the "North Farm" area of campus.

The weather station kept records for the Agriculture Experiment Station, and also became a source of data for the University campus, the Champaign-Urbana community, and the U.S. Weather Bureau.

This August the Survey celebrated the 100th anniversary of what became known as the Morrow Plots weather station. Former weather station observers were invited to participate in the August 17 ceremonies at the Survey.

Some of the weather instruments at Morrow Plots on the University of Illinois campus in a 1960s photo.

In 1963, because of the long continuous records at the Morrow Plots weather station, the U.S. Weather Bureau designated the station a benchmark station for the study of past and future climatic changes in the United States. At that time, it was one of only 15 benchmark stations east of the Rocky Mountains.

Wayne Wendland, State Climatologist, says the daily weather observations have continued to the present without a break, which is unusual in weather recording but necessary for improved understanding of the climate.

Personnel Note

William C. Ackermann, Illinois Water Survey Chief from 1956-79, died in Champaign on Thursday, June 9 after a long illness.

Ackermann led the Survey during times of rapid growth, the environmental movement, student unrest, construction of an addition to the University of Illinois Water Resources Building, and changing technology.

During his tenure, the Survey's administrative home changed from the Department of Registration and Education to the Department of Energy and Natural Resources.

Ackermann received a degree in civil engineering from the University of Wisconsin in 1935. He served as an engineer for the Tennessee Valley Authority from 1935-54 and as head of the Agricultural Research Service in Washington, D.C. before becoming chief of the Water Survey in 1956. He is survived by his wife, three children, and seven grandchildren.

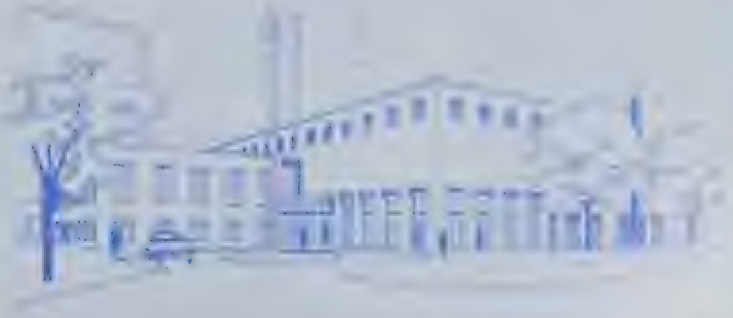
CENTERING ON WASTE

Hazardous Materials Lab Ground Breaking

On July 11 officials from the Illinois Department of Energy and Natural Resources (DENR), the University of Illinois and other state organizations broke ground for a laboratory that will become one of the few facilities in Illinois specifically designed for the chemical characterization and study of hazardous waste. DENR will administer the $8.7 million Hazardous Materials Laboratory (HML) through the Hazardous Waste Research and Information Center (HWRIC). The HML will be built on the southwestern section of the University of Illinois' Champaign-Urbana campus.

When the HML is completed in early 1990 it will house 41,400 square feet of laboratory and office space and will provide researchers with new laboratories equipped with state-of-the-art analytical and safety equipment for hazardous waste research, technical assistance and training in Illinois.

One important task of the HML, which is the culmination of more than four years of planning, will be to encourage hazardous waste researchers from academic, governmental and industrial sectors to use the facility to conduct their research. HML staff will



The Hazardous Materials Laboratory

provide the analytical and logistical support for these efforts.

Another important task of the HML will be to provide training, in cooperation with state and federal programs and needs, in the areas of safe laboratory practices, and hazardous waste and toxic substance management.

The building will house four distinct areas for research. These areas will include the biological lab, the treatability labs, the high hazard labs and the pilot lab. The toxicity of environmental samples will be researched in the biological lab while bench-scale treatment experimentation will be conducted in the 720 square feet treatability labs. The 1,500 square foot high hazard area will consist of four labs equipped with special air handling equipment to provide rapid turnover of room air, thus preventing lab vapors from escaping into the rest of the HML. In addition, the building will house the administrative offices, library, clearinghouse and computer facilities of the HWRIC.

MOM Helps Clean Up Industrial Waste

Generators of industrial waste will soon be looking to MOM (the Multi-Option Model) to find answers to their disposal and waste recycling problems. The Multi-Option Model, a new, interactive computer program for waste reduction being developed by HWRIC, waste reduction agencies in other states and the U.S. Environmental Protection Agency, will help generators learn new waste reduction and recycling options by guiding them through a series of questions and answers on a computer screen.

Generators will put information regarding the amount and type of waste they generate into the program. The MOM program will then offer the generator information in these areas: waste reduction, exchange and available treatment, storage and disposal facilities.

Calumet Ground And Surface Water To Be Studied

The HWRIC recently released plans to evaluate ground and surface water contamination in the Lake Calumet area. The plans outline comprehensive five-year programs to study the location, types and concentrations of contaminants present in the area's ground and surface water, and to determine whether those contaminants are harming the quality of Lake Calumet or Lake Michigan through groundwater seepage or surface water flow.

The $1 to $1.5 million groundwater study, which has a variety of potential funding sources, will be conducted by a team of researchers from the Illinois Water Survey Groundwater Section. The project will provide the basis for a longterm groundwater monitoring program in the Calumet area that will track changes in groundwater quality, determine the possible human health effects of exposure to contaminants and determine the sources of contamination.

It will also provide the information necessary to make informed policy decisions about prioritizing in cleaning the hazardous waste sites, using land in the area and protecting public health and the surrounding environment, including Lake Michigan.

The contamination of the Calumet area surface water would be a second area of study. Researchers from the Water Survey Surface Water Section will study the extent of the surface water's contamination and its contribution to the pollution of the area's groundwater, Lake Calumet and Lake Michigan. The research team will design and install a longterm surface water monitoring program with goals similar to those of the groundwater monitoring program.

GEOGRAMS

Survey Helps In Search For Car And Body

Recently the Geological Survey was involved in an unusual use of its resources — assisting police in the search for a car containing a missing body.

This spring the Blue Island (Illinois) Police Department (BIPD) received a tip that a car with a missing woman's body was in the Calumet Sag Channel. Dredging and diving techniques proved unsuccessful in locating anything in the channel.

After seeing a television news report about the department's efforts, consulting geologist Harry Smedes contacted the police and suggested that the Survey's resources might help the search.

In late June, in cooperation with the BIPD, three Survey scientists travelled the channel in a canoe using a magnetometer to detect unusually high amounts of metal submerged in the channel, which could signal the presence of an object like a car. They found three areas containing higher than average amounts of metal: one was a previously identified car, another was undeterminable (it was buried too deeply in mud for divers to identify), and the last was a car stolen from Chicago in 1984.

The location of the car with the missing woman remains a mystery, but the location of a missing stolen car was resolved.

Maximizing Coal Production And Protecting Farmland

The Illinois Mine Subsidence Research Program (IMSRP) was established in 1985 to develop guidelines for underground mining methods which would maximize coal extraction while preserving the agricultural productivity of prime Illinois farmland. The program was initiated at the request of the Illinois Coal Association and the Illinois Farm Bureau and is directed by the Illinois Geological Survey (IGS), with the U.S. Bureau of Mines and the Illinois Coal Development Board funding the research.

As part of the program University of Illinois agronomists have completed a three-year study to assess the impact of mine subsidence on prime farmland. Other researchers are using field and laboratory techniques to investigate the mechanisms of mine subsidence including in-mine floor and pillar strengths. Field instruments are used to monitor the movements and changes in groundwater. Surface soil changes are also being monitored before, during and after subsidence events using field instruments.

To bring the coal and farm industries up to date on IMSRP projects, results and plans, an industry briefing was held on August 16 in Mt. Vernon. A five-year Memorandum of Agreement, signed by the State of Illinois and the U.S. Bureau of Mines, insures collaboration and cooperation through 1991. Research will likely be followed by longwall demonstration programs coordinated with coal mine operators by 1991.

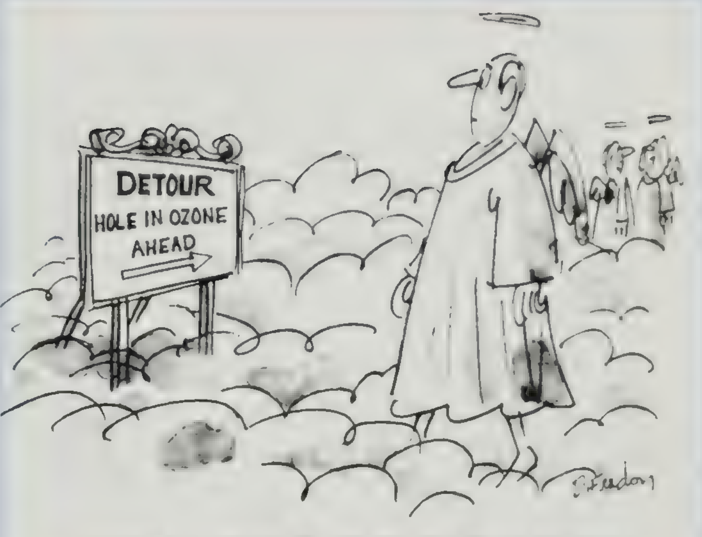
Special Maps Spot Mineral Resources

The geology of southern Illinois, which is rich in mineral resources, is more complex than other parts of the state and its details are only now beginning to be understood. In 1981 the Illinois Geological Survey undertook a program of detailed geological mapping in the region with support from the Nuclear Regulatory Commission (NRC). Mapping in the area was renewed in 1984 with federal matching funds from the Cooperative Geologic Mapping Program (COGEOMAP) of the U.S. Geological Survey.

The area being mapped extends northward and westward from the Southeastern Illinois Flurospar Mining District mapped by Illinois Geological Survey (IGS) scientists 20 years ago. Extensive fault zones in the region and the historic New Madrid Earthquake (1812-13) in nearby Missouri led the NRC to ask questions about possible modern fault movements that could damage nuclear power plants. Geologic mapping by IGS geologists revealed no dangerous faults, but instead found new details about the geology of the region that were broadly encouraging for mineral resource exploration.

Renewed efforts by IGS mappers have located new seams of coal that are potentially attractive targets for exploration. Detailed mapping also is changing geologic concepts of the region in ways that could provide new tools for successful oil and gas exploration.

The first three geologic maps produced in the program were published in the summer of 1986 and are available for $5 each. Three additional quadrangles have been mapped and are being edited for publication in 1988 or 1989. Thereafter, two quadrangles will be completed each year.



Drawing by D. Fradon © 1988 The New Yorker Magazine

SHORT TAKES

Rabbit Hits The Big Time

It's out of the burrows and on to the big time for our furry friend Roger Rabbit. Rabbit, of the *cartoonus* family and *loonus* species, starred in the summer's hit movie "Who Framed Roger Rabbit?" Rabbit says he's proud to represent the animal kingdom on screen and admits that it took a bit of adjusting at first. "I'm not used to having all of my meals provided. I was expecting them to just turn me loose in a clover field for lunch." Rabbit got his break when a Tinsel Town agent spotted him in his former act, as he was pulled out of his partner's hat. What's his next act? "Well, I'd really like to hit the boards seriously, as Othello maybe," Rabbit says. But

Roger Rabbit, out of the burrows and onto the screen. (© MCMLXXXVIII Touchstone Pictures and Amblin Entertainment, Inc. All Rights Reserved.)

then he's retiring to start his own animal actor agency. "It's time that animals' talents are viewed more seriously. We can do a lot more than jump through hoops and dance," he says. Rabbit says his agency, tentatively called "Animals R Us," should open around 1990.

IEPA Helps Clean Up Farms

The Illinois Environmental Protection Agency routinely gets calls from farmers who want to know how to properly dispose of leftover hazardous wastes such as herbicides, pesticides and waste oil. Proper disposal means transporting the waste to St. Louis or Chicago, where the nearest incinerators are located. Since this is very costly (about $2,400 per 5 gallons of liquid pesticide), some farmers let the containers sit and rust or dump them on unused farmland, which contaminates the land and groundwater. So the IEPA, in conjunction with the Adams County Cooperative Extension Service, sponsored a Pilot Farm Chemical Disposal Program in Adams County. The agency sent letters to area farmers explaining that if they would bring certain types of their hazardous waste to the county fairgrounds on June 3, the agency would properly dispose of them for no cost. Two percent of the farmers participated. The IEPA collected more than 10,000 pounds of waste and would like to offer this program in all counties if state money becomes available.

Drought Doings, Or The Irony Of It All

June was proclaimed "Illinois Rivers Appreciation Month," and June 20-25 was "Water Quality Week in Illinois." Mother Nature didn't get those press releases.

Don't worry about those globs of green and brown foam floating down our rivers, they're just oxygen-starved algae which have been forced to the top because of heat and low water levels.

It's nice to know that the drought helped somebody. Illinois coal usage was expected to increase this summer because of higher energy demand from greater air conditioning use and overall drought effects.

Things Could Be Worse

While the summer's drought has left us lamenting Mother Nature's heartless ways, things could, and have been, worse. On March 8, 1925 the Tri-State Tornado hit Illinois and lasted three and a half hours (the standard is 10 to 15 minutes), averaged 62 mph (the norm is 20 to 30), and left a damage zone of one-half to one mile wide and 120 miles long. Six hundred ninety-five people died in Illinois, Indiana and Missouri, and 2,027 were hurt. Losses totaled $101.9 million dollars (in 1985 dollars). Between June 19 and 20, 1964 thirty-three hail storms plagued central and southern Illinois in 18 hours, causing $34.8 million damage and destroying at least half of 369 miles of cropland.

The Stork Arrives For The Peregrine Falcons

A pair of state and federally endangered peregrine falcons became the proud parents of two offspring this year, believed to be the first peregrine falcon births in Illinois since 1951, when the last peregrine nest was sighted.

The mother and father, which nested on a building ledge 34 stories high, were released in Chicago during the past two years as part of urban peregrine release programs. (Five birds were released in 1986, 11 birds were released last year and at least ten will be released this year.)

Peregrine falcon populations declined in the 1950s with the use of the pesticide DDT which prevented the birds from absorbing calcium and in turn thinned their egg shells.

Mark Spreyer, Chicago Peregrine Release project Director, said he hopes to leave the birds undisturbed in their sky-high nest since even banding them might be too much of a disturbance. (Interesting sidenote: The July issue of the Department of Conservation's *Outdoor Highlights* announced Spreyer's recent engagement to a Lincoln park zoo associate veterinarian named . . . Dr. Peregrine Wolff.)

Collections Corner

Most people have collected things at one time or another, from stamps to bills to coins. But for Illinois survey scientists, it's part of the job. Take for example the Natural History Survey. Scientists there started collecting animal and plant samples in 1858 and have built up several different types of collections, some with millions of specimens. (Unfortunately some of the original specimens were destroyed in the historical Chicago fire.)

These collections serve important functions: they are a resource when scientists have to identify specimens (which may be foreign and new to the state or country) for research, state departments, universities and citizens; they document the past and present flora and fauna of Illinois and therefore assist environmental impact studies; they aid in student training; they provide material for basic research in specimen classification; and they keep important specimens which were used in specific research.

Dr. Wallace LaBerge, Head of the Faunistic Surveys and Insect Identification Section for the Natural History Survey, has collected bees for 23 years. (The bee collection makes up part of the Survey's nearly six-million-specimen insect collection). LaBerge estimates that there are tens of thousands of bees in the collection, many of which he caught and preserved himself. Some were collected between 1880 and 1905 by a Carlinville botanist and donated to the Survey; others are left over from the undestroyed part of the 1858 collection. LaBerge has collected bees in North America, Europe, Mexico and Central America. He has every species of bee that is native to Illinois and additional kinds found only in surrounding states.

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erflies and mo

Some of the Illinois Natural History Survey's more spectacular collections which are used for display and demonstration purposes.

Nature Preserves Commission Celebrates Silver Anniversary

The Illinois Nature Preserves Commission was created in 1963 by the Illinois General Assembly. The nine-member, gubernatorially appointed, volunteer Commission has a four-fold mandate: to determine areas which qualify for dedication as Illinois Nature Preserves, to formally dedicate areas into the Illinois Nature Preserves System, to establish and oversee guidelines for their care and management, and to promote the preservation and educational, scientific, or passive recreational use of other natural areas. The Commission currently oversees 168 Illinois Nature Preserves, or 27,000 acres of natural lands, and 5,000 acres of land in its Natural Heritage Landmark Program. Commission staff has helped preserve thousands of acres of natural lands in Illinois.

Counting Our Endangered Plants

The Illinois Nature Conservancy started a new program this year — they're counting on volunteers to count Illinois' endangered plants. (The Nature Conservancy is a national, nonprofit organization dedicated to preserving the variety of life which currently exists on our planet.) At approximately 40 sites in the Chicago area and collar counties, the Illinois Conservancy's volunteers, or stewards, visit certain natural areas and monitor the performance of the area's endangered plants.

According to a Conservancy field representative this is a special program since the stewards performed highly skilled, scientific work. Each site has a different number of endangered plants and requires different counting methods. The Conservancy wants to look at the performance of the plants over a period of about ten years to determine if the various sites are being properly managed. But they want the stewards to keep counting long after that.

MUSEUM MOMENTS

As a new feature in this issue we are providing our readers with a calendar of events at the Illinois State Museum in Springfield, the Illinois Artisans Shop and the State of Illinois Art Gallery in Chicago's State of Illinois Center, and the Illinois State Museum in Lockport. The first calendar is a chronological list of events and exhibits at all four locations. The last calendar is a schedule of events at the Springfield museum's "Place of Discovery," a special area within the museum dedicated to children and their interests.

Chronologically Listed Events

September 4 - November 20:
Models, Maquetes and Studies of Major Works commissioned by the Illinois for Art Program, Illinois State Museum Lockport Gallery

September 19 - November 10:
Maurice LeGrand LeSueur Sullins: Paintings 1970-1986, State of Illinois Art Gallery

September 25 - January 1, 1989:
Collection Update: Painting, Sculpture, Drawing and Prints, Illinois State Museum, Springfield

October 1 - 31:
Skeleton Quilts and Masks featured at the Illinois Artisans Shop

October 14, 11:00 a.m.:
Country Crafts demonstrated at the Illinois Artisans Shop

October 28, 6:00 p.m.:
Halloween Event, Illinois State Museum, Springfield

October 28 - 29:
Sculpture Film Festival, Illinois State Museum Lockport Gallery

November 1 - 30:
Rural Christmas Prints featured at the Illinois Artisans Shop

November 5, 10:00 a.m.:
Collectors Day, Illinois State Museum, Springfield

November 18, 11:00 a.m.:
Christmas ornaments demonstrated at the Illinois Artisans Shop

November 21 - January 6, 1989:
Survey exhibition of the Illinois Arts Council Partners in Purchase Program, State of Illinois Art Gallery

December 1 - 31:
The Elves of Christmas featured at the Illinois Artisans Shop

December 4 - February 12, 1989:
ABC: The Artist, the Book and the Child exhibition, Illinois State Museum Lockport Gallery

December 9, 11:00 a.m.:
Holiday Jewelry demonstrated at the Illinois Artisans Shop

December 10:
Storytelling, Illinois State Museum Lockport Gallery

December 11:
Gaylord Building Open House, Illinois State Museum Lockport Gallery

January 14:
"I Can't Draw" Workshop, Illinois State Museum Lockport Gallery

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Kids' Calendar: A Place For Discovery

October 15, 10:00 a.m. and 2:00 p.m.:
Discover Dinosaurs

October 29, 10:00 a.m. and 2:00 p.m.:
Lights Out! and Cave Wonders

November 5, 10:00 a.m. and 2:00 p.m.:
The World of Water

November 19, 10:00 a.m. and 1:00 p.m.:
Eskimos to Iroquois

December 10, 10:00 a.m., 1:00 p.m., 2:30 p.m.:
Holiday Fun

TRANSITIONS

IEPA Director Named

Bernard P. Killian, Director of the Illinois Environmental Protection Agency.

On July 29 Governor James R. Thompson named Bernard P. Killian as the Director of the Illinois Environmental Protection Agency (IEPA). Killian replaced Dr. Richard J. Carlson who resigned to form an environmental consulting firm based in Chicago. (Killian had served as Acting IEPA Director since May 4.)

Killian, 44, joined the agency in 1974 as a legislative liaison. In 1980 he became Manager of Public Programs and in 1984 served as Manager of Government and Community Affairs.

He guided the IEPA's legislative programs through substantial changes, including comprehensive hazardous waste legislation, the establishment of the State "Superfund" program, vehicle emissions inspections law, the Illinois Chemical Safety Act, the Solid Waste Management Act and the Ground Water Protection Act.

Killian received a law degree from the University of Chicago Law School in 1969 and a bachelor's degree from the University of Notre Dame in 1966.

No one is sure when it began.
No one is sure when it will end.
And no one is sure
what caused it.

HOT and DRY

For months the weather forecast was "continued hot and dry." Forty percent — fifty percent — sixty percent chances of rain never materialized into the real thing. Birds patiently perched on lawn sprinklers, Chicagoans were ozoned indoors, and farmers . . . well, farmers simply despaired.

Illinois was running on empty.

A Rain Deficit

A drought is in the eye of the beholder.

Farmers worry about changes in crops and germination rates, the impacts of less rain rather than less rain per se.

Residential water supply users don't get excited until one to three months after the rainfall shortage occurs, when wells begin to go dry.

The surface waters of the state don't show a change until four to six weeks after the precipitation trend changes.

There is no one good quantitative definition of what constitutes a drought. According to Wayne Wendland, State Climatologist with the Illinois Water Survey, when precipitation amounts are extremely low relative to normal for six weeks or more (say one- or two-tenths of an inch), then you may have a drought on your hands.

"We started to worry at the end of April, when rainfall was 46 percent of average throughout the state," says Wendland. "May precipitation was 44 percent of average. We knew we had a drought then, and our worst fears materialized in June when Illinois received only 23 percent of its average rainfall for that month. The intensity of the drought was reduced in some areas of the state in July, with the statewide precipitation for July at 56 percent of average (normal). Unfortunately, the west central and central sectors of the state received far less than this amount."

"The average rate at which a drought of this intensity occurs is once every ten years, not at all unusual. What is unique and most disturbing about this drought was that the rainfall shortages occurred in the spring, usually our wettest months. Most Illinois droughts occur in the late summer and fall. The public's attention isn't really drawn to a drought situation until it sees the impacts of reduced rainfall on agriculture, water supplies and recreation. All hell broke loose in the first two weeks of June, when the media picked up on the trend. It took most people six to eight weeks to realize something was going on."

This year's monthly springtime rainfall averages were almost as low or lower than those of the infamous drought years of 1934, 1936 and 1953, which also experienced springtime droughts. Comparisons with the Dust Bowl years were inevitable, although improved farming practices prevented the soil losses seen in those years.

Illinois was not wilting alone. Twenty-three other states were severely affected by the drought. Northwestern Wisconsin, the northern half of Minnesota and all of North Dakota were in worse condition, receiving only 30 percent of their average rainfall for April, May and June. By mid-July Minnesota had lost half or more of its wheat, soybean and corn crops. The North Dakota Farm Bureau estimated that the drought will cost that state $2.6 billion.

Brief respites from the drought came with occasional rains in some areas of the state. In general, however, rainfall deficiencies since January are in the -7 inch to -12 inch range, with the greatest deficiencies in the west central part of the state. Using past climate as a guide, there is less than 10 percent probability that the rain deficit will be remedied by April 1 of next year

The Omega Block

In an average summer the jet stream at 30,000 feet is over central and northern Wisconsin, flo

(L) Regular hybrid (R) Drought resistent hybrid

west to east. Precipitation is generally found 200 miles north of and along that jet stream. The earth's near-surface flow of air typically moves from the Bermuda high to the western Gulf of Mexico north over eastern Texas, eventually curving northeast over Illinois. It brings with it warm and humid weather.

In an average year, rising, moist, counterclockwise winds known as cyclones promote rain. These are followed by the development of anticyclones, high pressure systems in which dry air gradually descends toward the ground, moving in a clockwise pattern around the center. These cyclones and anticyclones alternate to render the nation's usual weather pattern.

That is what happens in an average year. This year was not an average year.

For some reason not yet known to atmospheric scientists, this year an anticyclone stalled over the central United States and split the jet stream. The northern jet stream veered into southern Canada, and precipitation moved alongside and north of it, completely missing the Farm Belt. The southern jet stream moved to the southern United States, blocking Gulf moisture from coming north.

The combination of the stalled high pressure system and the split jet stream is known as an Omega Block because of the omega-like circulation pattern over the United States. Scientists do not know what caused it.

The cause of the Omega Block may not be clear, but its effects are. From April through early July, the air blowing into Illinois came from the desert regions of west Texas, causing relative humidity to be much lower than average.

Temperatures during that time period were also very un-average: highs that were five to nine degrees above the average, and lows that were two to three degrees below the average. The variations in daytime and nighttime temperatures were severe.

The Scorched Earth

After the meager rainfall in mid-July, the farmers' refrain was "Every little drop of rain helps, but . . ."

Another drought victim

The unspoken "but" was the damage already done. Particularly hard hit was the corn crop which was in the process of pollination. Many corn crops had some kind of tassel (the male flower), but the female component, the silk, simply wasn't there or was dried out. No longer receptive to the pollen grains released from the tassel, the silk was incapable of forming kernels in the ears.

State Director of Agriculture Larry Werries estimated that the average corn crop yield in Illinois would be less than 70 bushels an acre. The U.S. Department of Agriculture (USDA) estimates that the nationwide corn crop at 4.48 billion bushels, the smallest since 1983 and down 37 percent from 1987's crop of 7.06 billion bushels.

Experiencing similar difficulties was the soybean crop, which Werries predicts to be considerably less than the USDA's nationwide estimate of 1.47 billion bushels. The state average yield will be 25 bushels or less per acre.

"Many farmers in Illinois face complete loss of their crops, while some will have substantial crops," according to Dr. Steve Hollinger of the Water Survey. "In the last two to four weeks of the growing period from mid-August to mid-September, dry weather means a decrease in the quality of the corn crop as well as a decrease in the quality and yield of the soybean crop."

With rivers and lakes down and increased threat of fire to dried vegetation, Illinois' wildlife was a drought victim too. Fish, especially sport fishes like the bass, crappie and bluegill, were finding themselves trapped in shallow tributaries. Their breeding time is also long past, so there will be small crops of new fish. Fish in the state's farm ponds were endangered by a lack of sufficient oxygen caused by shallow waters and high temperatures.

Birds' reproduction rates were low, there was a significant reduction in their insect food supply both for themselves and their young, and birds like robins could not build nests without the mud needed to hold the nest together.

Grassland nesting wildlife in Illinois (pheasants, quail, rabbits, many songbirds, etc.) suffered indirectly from the drought, when about the first of July, the U.S. Department of Agriculture approved haying on Conservation Reserve Program (CRP) lands in 13 states. CRP lands in all states are now open to haying, coming at that critical time when many species of grassland wildlife were nesting. CRP lands were signed up for 10 years, with owners given annual payments to idle their land and money to establish cover crops. These cover crops are now in jeopardy from both mowing and drought.

Waterfowl was extremely vulnerable, with little water at nesting places. "Dabbling ducks are in big trouble, because they nest in prairie potholes, and those potholes are just plain dry," reported Glen Sanderson of the Natural History Survey. "Some diving ducks will be all right, but some nest on vegetation in marshes and those marshes are drying up. Waterfowl in the prairie provinces of Canada, the Dakotas and Minnesota are in very bad shape. Adult ducks will head north of the prairie potholes where there is permanent water for a better food supply, but they won't breed up there. "Fall populations of ducks are usually about 50 percent young birds. Duck populations were down to begin with, what with two to three years of bad water conditions. It's just going to get worse."

"As for other species, direct mortality rates may not be too high, but the smaller creatures like rabbits and squirrels, shrews and mice will have a hard time finding a decent food supply. Rabbits need tender vegetation, and they're not going to get that with these conditions. As for the squirrels, the acorn crop is in bad shape, and litters will be small as a result. There will be some effect on deer as well. Like rabbits they need more tender vegetation. Oppossums, raccoons and the like should do all right since they have a more varied food supply — carrion, fruits, vegetables, insects, etc."

Ozone Alerts and Sprinking Patrols

Things weren't easy on the human population either.

Chicago wheezed through a two-day "yellow" ozone alert, when ozone levels hit 200 to 300 parts per billion on July 7 and 8. The highest ozone levels seen in Chicago in a decade sent joggers, the elderly and everybody else with common sense indoors.

Most people throughout Illinois stayed indoors, and air conditioners sales flourished, as did the carwash, lawn sprinkler and garden hose businesses. Those brave souls who did go out found wilted gardens and brown scruffy-looking lawns. The more adventurous ran into or rather dove into trouble in swimming holes and lakes. Diving and resultant neck and spine injuries have become another aspect of the drought.

Water conservation was the order of the day. In north suburban Naperville midnight lawn soakers were in danger of tickets from municipal sprinking patrols. Parts of Kankakee and Iroquois counties declared water emergencies, forcing some communities to drill new wells or truck in water. At this writing, some communities like Springfield have imposed mandatory water conservation measures on everything from lawn sprinklers to water served in restaurants.

Recreational water use declined as river levels declined, with many streams at near record lows. Water levels in lakes and reservoirs also continued to decline. The water level of Lake Michigan decreased as well, placing the lake at its 100-year average level for the first time since 1977. In recent years lake levels have hit record highs.

(continued on page 24)

Drought And The Greenhouse Effect

by Stan Changon

The unexpected and severe nationwide drought of 1988, coupled with increasing claims of future global changes of warmer and drier climatic conditions as a result of the ever increasing release of carbon dioxide (CO_2) from the burning of fossil fuels and deforestation, have led more than one person to speculate about the possible tie between the two atmospheric issues. Was the highly unusual springtime drought in Illinois and elsewhere the first symptom of the climate change atmospheric scientists had been talking about for the past 10 years? The scientific community unanimously says "no," the 1988 drought is not tied to the ever increasing atmospheric burden of our waste gases. Normal climatic variability is sufficiently great to make this conclusion invalid. Regardless, the Greenhouse Issue has found international concern and is the single most critical atmospheric issue facing society. It will likely soon eclipse acid rain and the ozone layer problems. The Greenhouse concept says that CO_2 and other trace gases with comparable atmospheric properties (methane, CFC's, and nitrous oxides) will act as a "window" letting the sun's energy in but not letting as much re-radiation back into space, leading inevitably to global warming and changes in all weather conditions.

What do we know? There is clear evidence that CO_2 and the other trace gases are steadily increasing; the decadal increase of CO_2 is 4% in the earth's cleanest air, that over the central Pacific. Second, there is strong scientific agreement that these increases will lead to global warming. Global Climate Models (GCM's) developed over the last 15 years on huge computers by climatologists at four U.S. research centers, have been used to model the future Greenhouse Effect (the radiation balance in GCM's is changed to emulate the gaseous effects on the atmosphere). They all predict that between 30 and 70 years hence, global warming will occur. Their warming estimates range from one to four and one-half degrees Centigrade, with the greatest warming at the Poles and the least near the Equator.

What we do *not* know? The GCM's require a myriad of scientific assumptions. Note that their widely differing predictions (one to four and one-half degrees change and each requiring very different time periods to develop) reflect a lack of precision; they are still primitive in many ways. Atmospheric scientists cannot specify, in any accurate way, how the climate changes will occur . . . will they be gradual or in a few major jumps interspersed with no change? (Such uncertainties also make any association with the drought of 1988 impossible.) The GCM's have poor spatial resolution and their predictions for future climate conditions over areas like the Great Lakes are widely different. For example, the output of one GCM indicates that in 50 to 60 years, the level of Lake Michigan will be two feet lower than today's average, whereas another GCM output leads to a nine foot decrease! This difference creates vast differences in the likely effects on water supplies, transportation, and the economy of Chicago, of Illinois, and the U.S. and Canada.

What do we need to do? This essay does not deny the seriousness of the Greenhouse issue, but attempts to put it in perspective. The major scientific uncertainties make it difficult to adopt restrictive policies that of necessity would have far-reaching impacts on national global economic growth. The watchwords are *research* and refinement of the GCM's, and close and careful *monitoring* of the climate.

A Day In The Life Of

The Havana River Research Laboratory

By James Krohe Jr.

For more than 90 years its scientists have hunted fish from aboard horse-drawn wagons, camped in floating houses, been bombed by birds, dived into water so murky that they had to see with their hands instead of their eyes "Only certain people like to work in a field station," explains Stephen Havera, a doctor of ecology who is director of the Havana River Research Laboratory on Lake Chautauqua in Mason County. "It's not that plush."

Forbes' Foresight

In 1895 Dr. Stephen A. Forbes, founding Chief of the Illinois Natural History Survey, complained that students, indeed science itself "suffered . . . from lack of opportunity to study nature alive." Thanks to Forbes the study of nature in Illinois has been very lively indeed ever since. It was largely at Forbes' suggestion that the then-State Natural History Laboratory established in 1894 a biological research station at Havana, on the backwaters of Illinois River.

It was the first inland aquatic biological station in the country manned and equipped for continuous investigations and the first to dedicate itself to the study of a major river system. Even today, it is still one of only a handful of such stations on the large floodplain rivers, as what was begun on the Illinois River 94 years ago has since been undertaken on the Nile, the Volga, and the Amazon.

"The creek has never been down this far," Havera observes as he trudges across a footbridge which connects the lab grounds to the shore of Lake Chautauqua. The bridge crosses Quiver Creek, which owes its survival in dry years to cool water springs. In the shadow of the bridge a cohort of young channel catfish gorges on minnows. Nearby a gar lies still in the water like a broken log with teeth; a few yards upstream a great blue heron — what Illinois' pre-eminent nature writer John Madson once described as "a fishspear with an attached bird as a life-support system" — stands at attention.

What a remote field research station cannot provide in plush it makes up for in proximity. "In Champaign, you get into the field maybe once a week," Havera says, recalling his own experience at the Illinos Water Survey, "and then it takes a two-hour drive to get there." In contrast, the Havana station offers convenient daily access to riverine marshes, floodplain forests, mud flats, and of course the Illinois and (barely 75 miles away) the Mississippi. Says Havera, "It's monitoring the same population and habitat year in and year out that gives you an index to measure variation."

In ecological science, you can't understand the way things are unless you understand how things used to be. Because senior scientific staff have been stationed at Havana almost continuously for nearly a century, they have been able to measure the river's response to a variety of man-made "perturbations", from increased flow from diverted Lake Michigan water to sewage pollution to sedimentation to the introduction of alien species such as the common carp and the Asiatic clam. Havera slaps at a stinging fly which was claiming this spot of shore, then points out that the only reason there *is* a Lake Chautauqua during the rain-short summer of 1988 is that water is being pumped into it. "Droughts come and go. But we've modified the environment so much. Those fish back there are in a foot of water. In the 1930s they'd be in three feet of water."

Havera is one of three senior scientific staff presently at the Havana Lab. His colleagues include Richard Sparks, an aquatic biologist who specializes in mussels and other creatures that live in the bottoms of rivers and lakes, and Frank Bellrose, an ornithologist who has made a lifelong study of the birds which float on and fly above them. They are joined by as many as 19 junior scientists, interns, and support staff, plus farther-flung associates. The lab is isolated physically but not bureaucratically. Ecological research tends to be not just interdisciplinary but interagency in nature. The lab staff works in conjunction with the other Illinois scientific surveys and state universities as well as assorted federal wildlife and environmental agencies.

Mussels are studied in a simulated environment

Learning and Teaching

In its early years, Survey scientists worked out of houseboats outfitted with bunks and stoves which were moored in area lakes. In 1939 permanent quarters were built next to Lake Chautauqua. That small frame building has been outgrown several times since, and a $100,000 addition was recently finished which quadrupled available space. The new 3,500 square feet provide expanded conference and library space, a computer room, even office space for visiting scientists.

Havera is called to the telephone. A plan to fell 79 trees near Rice Lake has excited local controversy, since the trees are near an eagle roost. A meeting is being held that evening to discuss it, and Havera is asked to attend. "My kid's got a ball game tonight," he laments.

Such requests are common. Science intersects recreation, wildlife protection, environmental protection, and the expertise of the lab's staff is often in demand. Long-term research gets them involved in short-term controversies. "In 1982 there was a big mussel die-off, so mussels became suddenly important," Havera recalls. "Or it might be 'Save Peoria Lake!' "

Part of the lab's role is to teach as well as learn. Havera appreciates the need for public education, but talking about science is not science. Lab staff have to write press releases, conduct tours for the press, be interviewed on TV, lead seminars for visiting students, give speeches, even identify birds killed in combat with U.S. Air Force planes.

The laboratory's office building is itself an exhibit. The walls are festooned with photos of scientists in straw boaters and neckties collecting mussels the size of dessert plates, of before-and-after scenes of drained or silted-up lakes, of forests of water plants that aren't there anymore and of mud flats which are, of several generations of investigators diving, seining, tagging, and measuring everything that ever swam, flew, crawled, or grew — from eagles to benthic macroinvertebrates. Dr. C.A. Kofoid, superintendent of the Havana station from 1895 to 1900, published 1,000 printed pages on what he learned about Illinois River plankton alone.

Havana River Research Laboratory — INHS

Ducks under study

Havera excuses himself again, to have a word with a colleague who has just returned from a morning aboard one of the lab's mini-navy of 9 watercraft. Havera describes the channel catfish he'd seen in the creek, adding some distinctly non-icthyological judgments about how one of them might taste on a plate. "That's Brian Todd," Havera resumes. Todd and co-investigator Frank Dillon are trying to learn more about the movements of the channel cats. Radio transmitters were surgically implanted in some three dozen fish which were then released into area streams. Their locations can be tracked in shallow water from as far away as a half-mile, 24 hours a day, data which should be useful in identifying (and thus possibly expanding) the preferred habitats of this valuable sport and food fish.

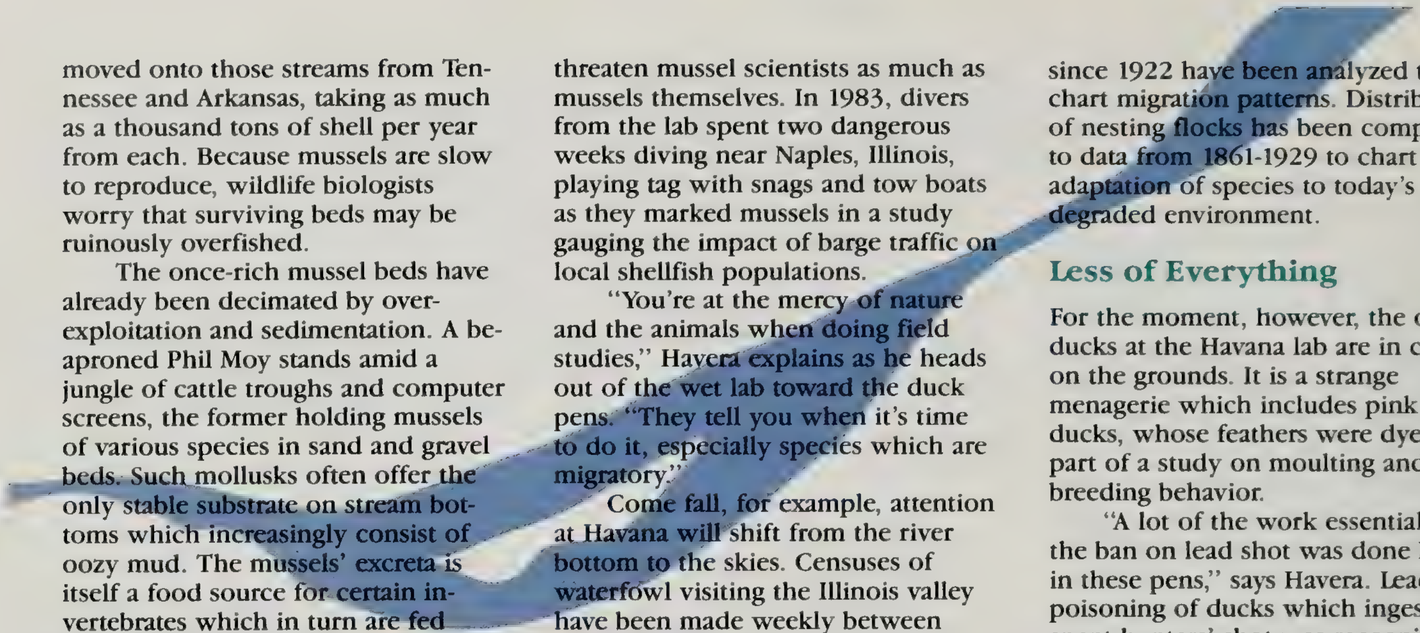
Old Questions, New Answers

"We're doing things now that they didn't have the instruments to do twenty to forty years ago," Havera explains. Gas chromatographs have been used here to analyze the blood chemistry of ducks that have ingested lead shotgun pellets, for example, and computers are invaluable in digesting large amounts of information about the distribution of and fluctuations in waterfowl populations.

Much of the lab's work involves finding new answers to old questions. Writing in 1958, George Bennett noted in the *Illinois Natural History Survey Bulletin*, "Many of the early activities in the management of aquatic resources of the United States were based on premises which later research proved to be inaccurate." For example, corn, buckwheat, Japanese millet, and milo have been the staple foods offered by waterfowl managers since the 1930s. Ducks eat them, certainly. But Havana researchers had established 50 years ago that duck feeding habits varied with available foods. Their preferred natural diet is highly varied, consisting of moist-soil plants such as smartweeds and nutgrasses along with pecans and pin oak acorns. Those foods have largely disappeared, however, leaving waterfowl increasingly dependent on simplified managed diets which, research suggests, are not as nutritional as wild diets. (Ducks fed exclusively on corn, for example, actually lose weight.)

Havana Research Station's main building

There are new questions which need answers too. Havera leaves the office building and crosses a dusty gravel drive to the facility's wet lab, a former storage building converted for the moment into a combination aquarium and TV studio. The cultured pearl industry in Japan is paying top prices for mussel shell from the Mississippi and the lower Illinois. Commercial musselers have



moved onto those streams from Tennessee and Arkansas, taking as much as a thousand tons of shell per year from each. Because mussels are slow to reproduce, wildlife biologists worry that surviving beds may be ruinously overfished.

The once-rich mussel beds have already been decimated by overexploitation and sedimentation. A be-aproned Phil Moy stands amid a jungle of cattle troughs and computer screens, the former holding mussels of various species in sand and gravel beds. Such mollusks often offer the only stable substrate on stream bottoms which increasingly consist of oozy mud. The mussels' excreta is itself a food source for certain invertebrates which in turn are fed upon by fish. But the link between mussels and game fish may be even more intimate. "Fish and mussels clearly share a close relationship," says Moy. "Mussels have to parasitize a fish as part of their reproductive cycle, for example, or they can't survive. But we don't know exactly what happens."

To find out, Moy and a colleague set up matched tanks. Mechanical paddles, gravel, and filtered light simulate a stream-bottom environment, half of which is populated by mussels, half bare. A single fish swims in each. A video camera linked to a computer constantly records the fish's position in the tank at one to two second intervals. Different species of fish will be tested under different conditions (including breeding) in simulations of advancing complexity. If mussels do play some specific role in the lifecycle of game fish, regulation to restrict commercial musseling might be warranted.

At The Mercy Of Nature

Mussels have always figured prominently on the scientific agenda at Havana. Although of diminished commercial importance, mussels are still vital to diving ducks as food. To the human ecologist, they are vital as pollution monitors. To riverine inhabitants in general they are vital as waste assimilators and purifiers. Their numbers and variety have been decimated by sedimentation and over-harvesting; a 1966 survey by then-director William Starret found only half the species of mussels along the Illinois that had been reported prior to 1900. More modern dangers threaten mussel scientists as much as mussels themselves. In 1983, divers from the lab spent two dangerous weeks diving near Naples, Illinois, playing tag with snags and tow boats as they marked mussels in a study gauging the impact of barge traffic on local shellfish populations.

"You're at the mercy of nature and the animals when doing field studies," Havera explains as he heads out of the wet lab toward the duck pens. "They tell you when it's time to do it, especially species which are migratory."

Come fall, for example, attention at Havana will shift from the river bottom to the skies. Censuses of waterfowl visiting the Illinois valley have been made weekly between September and April for 50 years, with less comprehensive surveys made of waterfowl and eagles along the Mississippi in years since. Pioneering studies of duck feeding and nesting habits were made at Havana beginning in 1938, as well as research which supported the economic and ecological utility of wildlife refuges. Much of that was done by Frank Bellrose, who has been widely recognized as having done for ducks what Johnny Appleseed did for orchards.

Unfortunately the great flocks of ducks and geese which visit the Illinois and Mississippi valleys have been dwindling. Looking toward the empty water of Lake Chautauqua, Havera says that more than 100,000, perhaps as many as a quarter million ducks (most of them mallards) will alight there in November to rest and feed. As recently as ten years ago, half a million birds could be counted there.

To find out why, an ongoing study of waterfowl management has occupied Havana staff for more than seven years. Waterfowl habitat has been inventoried for the first time since 1955. Food studies done by Bellrose from 1938-40 have been updated with the help of 11,000 birds of 14 species. Banding data amassed since 1922 have been analyzed to chart migration patterns. Distribution of nesting flocks has been compared to data from 1861-1929 to chart the adaptation of species to today's degraded environment.

Less of Everything

For the moment, however, the only ducks at the Havana lab are in cages on the grounds. It is a strange menagerie which includes pink wood ducks, whose feathers were dyed as part of a study on moulting and breeding behavior.

"A lot of the work essential to the ban on lead shot was done here in these pens," says Havera. Lead poisoning of ducks which ingested spent hunters' shot was recognized as long ago as 1870, but the precise physiology of the condition is still not fully understood. The rates at which such shot is ingested, the effects of "second dosing" on wild birds, and comparisons of lead levels in dead and live birds have all been investigated in recent years.

The impending federal ban on the use of lead shot is one bright spot in an otherwise gloomy chronicle. There are fewer species, fewer habitats, fewer lakes than when the lab first opened — less of everything in fact except pollution and sediment. The backwater lakes and sloughs so vital to the river ecosystem are filling up and converting to grass and then floodplain forest. "We've done in 50 years what nature would have taken 1,000 to do," Havera says. Even the lead shot ban (scheduled to take full effect in 1992) did not become law until more than a century after the problem was diagnosed. "How many ducks — and eagles which ate poisoned ducks — died in that time?"

Havera quickly adds, "How many eagles and ducks will that ban save over the next 100 years?" The circumstances of wildlife research leave the scientists based in Havana doing more postmortems than preventive medicine. The future may see more efforts to restore what could not be protected. If that happens, the knowledge accumulated here will provide the blueprint.

Until then there will always be more to learn, and people who will want to do the field research needed to learn it. "People do their best work," says Havera, "where they're happiest."

The mysterious domestic

A Thousand Secrets

Someone once said that a cat knows a thousand secrets and will tell none. Consider this: unlike most creatures, no one really knows how domestic cats came into being, or why, or how, or when or where.

According to *The Complete Cat Book* (Richard Smith, 1963, New York), several legends evolved around the cat's mysterious origin. One variation says the domestic cat was born when Noah, in order to solve the problem of plentiful rodents onboard the Ark, passed his hand over the lioness and she sneezed, producing the cat. Another legend says a bored lioness became enamored with the vivacious, curious monkey and their coupling produced the cat which exhibited characteristics of both parents.

Paleozoologists believe that the first scientific record of a cat-like creature was fifty million years ago when the Miacis, the cat's ancestor, lived. The Miacis evolved into the civet cat, which quickly evolved into the present domestic cat, although scientists have no understanding why this quick evolution occurred.

Stormy Start

While no one knows when cats first encountered man, it is known that cats have been domesticated for several thousand years and have alternately experienced periods of great favor and great rancor during their domestication. At one time Egypt was the cat's most fervent admirer, exalting the feline to the state of a deity. Royal cats received fish and milk-soaked bread, and were mummified and ceremonially mourned upon death. (Egyptians would shave their eyebrows upon their cat's demise.) The cat-loving Egyptians even made it a capital offense to kill a feline. The Moslems and Romans were similarly fond of their furry friend.

However, during the Middle Ages in Europe the cat fell from favor and experienced somewhat of a feline holocaust. The mysterious creatures were considered evil, even devils, and were burned en masse at lively public festivals, dropped from steeple tops, or used as targets for archery practice.

America welcomed the furry creatures as utilitarian friends. According to *The Complete Book of Cats* (A. Suchsdorf, 1956, New York), felines first arrived in America with the colonists and by World War II were stationed at every military base, depot, factory, shipyard and the like as the local controller of rodents. And the cat's popularity seems to be ever-increasing as urban dwellers opt for cats as pets instead of dogs because they generally require less space and care.

But with the increase in the number of rural and urban cats, people have also begun to question the feline's effects, if any, on other wildlife. Cats are well-known for their hunting abilities and habits. But some wonder if those habits are adversely affecting their prey and wildlife in general, and if so, what should or could be done about it.

Dr. Richard Warner, Wildlife Ecologist for the Illinois Natural History Survey, conducted a five-year study of free-ranging domestic cats in a rural area in east-central Illinois from 1977 to 1981. He wanted to try to determine the number of cats in Illinois and observe their general behavior, such as their movements, tolerance of other cats, and hunting and feeding habits because he thought doing so could help determine cats' impact on other wildlife. Warner also wanted to see if there were any feral cats in the area (a cat which has reverted to an untamed state and does not depend on man for its survival.)

To do this Warner and his research team garnered information by interviewing cat and farmstead owners in the area and by trapping cats and radio-tracking 11 adult cats for a period of about 30 days during each of the five years.

Cats As Free-Ranging Creatures

After tracking the 11 cats Warner discovered that the males, as popular belief may have it, were truly the wandering tomcats compared to the more stationary females. On an average the males travelled twice the area of the females. But both males and females spent almost as much time on farmsteads as they did on roadsides, field edges, farmstead perimeters, and waterways.

The males' gypsy ways decreased their lifespans. The far-ranging males were found to be more susceptible to death due to severe weather or other unknown causes. Both sexes of free-ranging cats had relatively short lifespans (four to five years) and were fairly susceptible to death as a result of human action or accident. Even so, Warner's study showed that overall the number of cats in this rural area increased from 291 in 1977 to 445 in 1981. This result was similar with pet food industry studies which showed the number of cats in national urban areas to be increasing.

However while the number of cats is growing, the types may not be, at least not in Illinois. Warner found no evidence to suggest that Illinois is home to true feral cats. He says feral cats like terrain that has plenty of holes and burroughs, much unlike Illinois' environment. But Warner did find transient cats, especially males, who roamed from farmstead to farmstead and finally stayed at one or died.

Cats As Hunters

While the cats studied were fed daily at the farmsteads, Warner discovered that all of the free-ranging cats still hunted, although to varying degrees. As evidenced by their deposits at the farms, the cats most often killed mice and rats, followed by small birds, rabbits, other rodents and pheasants. Warner says hunting is instinctual for cats, but he's unsure whether these skills would be sophisticated enough to keep the cats alive if other food sources weren't provided.

In summary Warner says the study's data indicate that between five to six million cats live in Illinois in rural and urban areas, and that cats are hunters by instinct. Since the increase in the national cat population has been generally unrestrained by government, Warner suggests that wildlife agencies try to discover the degree to which cats are depredating wildlife in certain environments and research appropriate ways to control the population of domestic cats, if necessary. He suggests that if cats are having an adverse effect on wildlife, the public could be made aware of the fact and the number of cats could be controlled. Warner says he doesn't feel there's currently enough information to launch a major public educational program, but that others disagree.

"The irony is that we're looking at the negative side of cats, whereas in the larger context it's a people problem," Warner says, explaining that humans may have a responsibility to be aware of cats' hunting instincts and to help control their depredation of wildlife by keeping them inside, having them declawed, or attaching bells to their collars.

However, pet ownership and the freedoms associated with it are sensitive issues. So far only 10 percent of America's county governments have cat-control laws. In fact, according to *The Complete Cat Book* (Smith, 1963), an effort to control domestic cats failed once already in Illinois. When Adlai Stevenson was governor, a group called Friends of Birds initiated a bill which would have required that cats be house-bound or leashed when outside. He vetoed it saying, "It is in the nature of the cat to do a certain amount of unescorted roaming."

Hot and Dry

(continued from page 19)

Landscapers and nurseries, which often guarantee new plantings, have been hard hit. In California the microchip industry felt the effects of the drought, as water needed to wash the chips fell short and more chips were rejected as a result. Barge traffic on the Mississippi slowed to a crawl, and a proposed diversion of Lake Michigan water to the river system failed.

When Will It End?

Good question, according to Wayne Wendland. "It's over when it's over. I wish I had a better answer than that, but the National Weather Service's long-term forecasts all suggest that we're in for hotter temperatures and average or below average precipitation. We still have seven to twelve inches of rain to make up. Of course I always take some perverse hope from the fact that once everyone is in agreement about the weather, it's bound to change."

And that may be as much hope as anyone can expect.

Dr. Wayne Wendland has been at the Illinois Water Survey since 1980 and is currently a Principal Scientist there. The State Climatologist for Illinois, he received his PhD in Meteorology from the University of Wisconsin-Madison. Dr. Steve Hollinger received his PhD in Agronomy and Agricultural Meteorology from Purdue University and has been a Professional Scientist with the Water Survey since 1984. Dr. Stanley Changnon has been with the Survey since 1952, serving five years as Chief. He is now a Principal Scientist and Chief Emeritus. Dr. Glen Sanderson is head of the Illinois Natural History's Wildlife Research Section.

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THE NATURE OF ILLINOIS

Winter 1989

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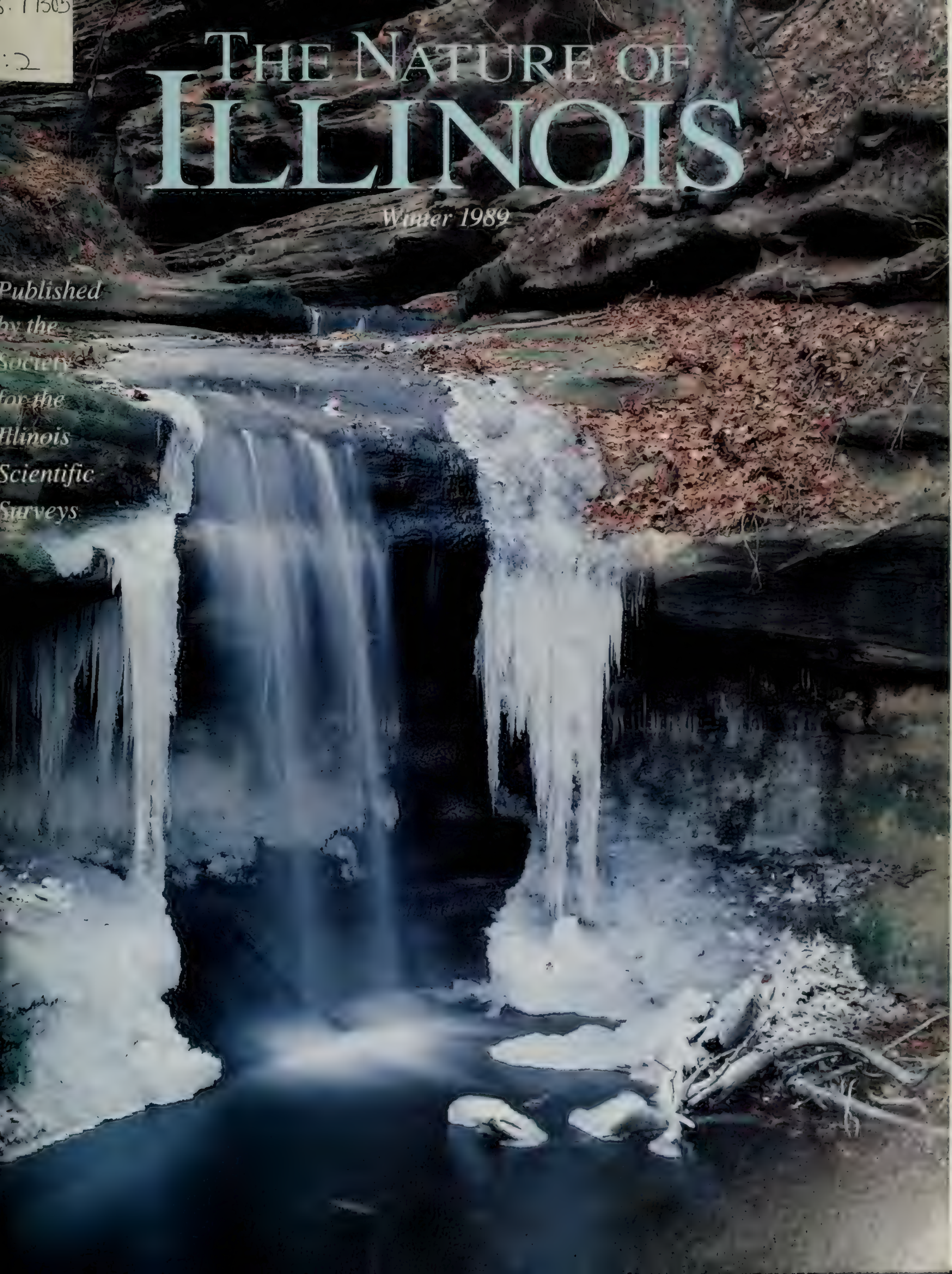

THE NATURE OF ILLINOIS

Winter 1989

The Society Page

This cold and snowy season may seem quiet, but beneath the surface is a veritable beehive of animal activity. If you've ever wondered about the winter of Illinois' furred, feathered and finned creatures, Survey scientists chronicle it for you in **The Winter of Their Content**.

The American Bottom is part of the vast Mississippi River floodplain, lying in Illinois between Alton and Chester. Join us in the first of a two–part feature on a part of Illinois where humans have lived and prospered for over 10,000 years.

In an earlier issue we looked at the work of Water Survey scientist Don Dolske in preserving the cultural monuments at Gettysburg National Park. We turn southwest now, where he is helping to preserve the cliff dwellings of the Anasazi Indians.

The resurrection and recreation of Illinois' wetlands is the focus of efforts by Dr. Donald Hey, Survey scientists and many others, and is also the focus of our article on the Des Plaines River demonstration project.

Most Illinoisans know about the great value of this state's coal reserves, but in this issue we will enlighten you about *fluorite*, the state's official mineral. Illinois produces ten percent of the nation's fluorite, used in the production of everything from toothpaste to space–walking propellants.

Three very talented photographers have developed a fascination with– and three books on– the landscape of Illinois. Our series on **The Art of Nature** looks at **Illinois In Camera**.

I am constantly amazed at the diversity of projects undertaken by our three Surveys in preserving the great beauty of Illinois. I hope you will join me in supporting their efforts by becoming a member of the Society. An application form is on the back cover.

Enjoy a peaceful and prosperous New Year.

Sincerely,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Tomorrow's Mineral
Found in beautiful hues ranging from royal purple to amber, the state's official mineral is used in the manufacture of products ranging from aerosols, refrigerants and teflon to "Tiffany" shades.

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Three landscape photographers focus in on Illinois.

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Waterfall, icicles, and leaves in a canyon in the Upper Dells, Matthiessen State Park, LaSalle County, Illinois. Photographer: Willard Clay.

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Editorial Staff
Jane A. Bolin *Editor*
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THE AMERICAN BOTTOM

by James Krohe, Jr

Child in East St. Louis

It is appropriate that the dominant landmark in a place called the American Bottom should be an Indian ceremonial mound named after French monks. The American Bottom (also known as the Bottoms) is the Illinois part of the Mississippi River floodplain lying between Alton and Chester, roughly 70 miles to the south. Today the site of the scattered urban complex of Metro–East, the Bottom has been home to humans for at least 10,000 years, and history is piled up as deep and as thick as the silts, sands and gravels which fill the river's ancient bedrock valley.

The French Influence

In its pristine form the Bottom was ecologically rich. It offered food in all seasons, wood for fires, chert (a form of flint) for tools, access to trade goods via the river, building sites, salt – all were close at hand. One modern anthropologist estimates that the Indians had everything needed for subsistence within three kilometers of any site in the Alton–Dupo section of the Bottom.

It was into this Eden that Marquette and Jolliet paddled in 1673. The French were the first Europeans to see the Bottom and the first to settle it. When Anglo pioneers first dared cross the Appalachians on their march from the Atlantic coast to the continental interior, the Illinois French already had a history half a century long. The village of Cahokia was founded as a mission to the Tamaroa Indians in 1698, the year before Williamsburg became the capital of colonial Virginia. Old Kaskaskia had a church in 1695, and by 1720 Fort de Chartres, upriver from Chester, was the seat of political and military authority which extended from Arkansas to the Great Lakes, and which prevailed until shortly after the British victory in the French and Indian War in 1763.

The French were Illinois' early civilizers. Missionaries and fur merchants set up churches and trading posts all along the Bottom, and the military followed with forts to protect them. The names on today's maps recall the French influence, even if modern pronunciations no longer do: Fort de Chartres, Prairie du Rocher, Carondelet, Renault. Never numerous, the French departed from pioneer stereotypes in many ways. They built with logs stood on end (two such structures survive in Cahokia), they farmed communally, and they lived in compact villages rather than on farflung homesteads.

Unlike later European arrivals, the French in Illinois were interested in trade

Old farmstead

more than territory. They farmed extensively, true, but as Carl Ekberg, the Illinois State University historian who has made a study of the Illinois French, says, "Agriculture became a part of their trade network. Illinois was the grain area of French Louisiana. A lot of grain was shipped to New Orleans along with deerskins and bear hides."

The American Bottom, of course, stands between the confluence of the Missouri, Illinois, and Mississippi to the north and the Mississippi and Ohio to the south, making it the intersection of a continental system of river roads which stretches from the Rockies to Pennsylvania and from the Gulf to Canada. The ancient Indians traded shell and precious metals along these rivers, the French pelts, lead, and grain. Later the cargoes would change, to grain and coal and crude oil and iron ore, but the river remained the focus of the economic life of the Bottom until well into this century.

Catholic church in Cahokia

The tenure of the Illinois French in the Bottom was cut short by political and military development beyond the Mississippi – France's defeat in the French and Indian War with Great Britain and, later, the American Revolution. The survey lines and roads of those early French towns shaped the subsequent physical development of the American Bottom, but their political and cultural influence was short–lived once Americans began arriving in numbers. Many French had already moved across the river to St. Louis when that village was founded in 1764, taking their culture with them; the Bottom village of Prairie du Pont, for instance, was renamed simply Dupo.

The Mississippians

The French did not realize it, but their saga of arrival, domination, and departure had been lived out many times before them in the Bottom by a succession of Indian peoples going back to the Stone Age. Evidence of ceremonial complexes, fishing and nutting camps, communal houses, burial grounds and tool–making camps from various eras have been found in all parts of the Bottom save the bluff face.

Recreating these ten centuries of occupation from their buried remains, however, is like trying to read a novel which is missing key pages. Few artifacts left by the Paleoindians who dwelt there 8,000–10,000 years ago have been found on the Bottom itself; they are believed to have been washed away by river floods or buried beneath dozens of feet of alluvium. Dozens of mounds built by the Mississippian peoples were plowed; the cliff near Alton which bore the magical painted image of the Piasa Bird (probably a pictograph of an Indian

SHELLS
DEER SLUG

Storefront

"medicine bird") reported by Marquette and Jolliet was quarried for limestone. Such is usually the habit of conquerors; the stone used to build the last Fort de Chartres in the 1750s was cannibalized by locals who used it in the foundations of their own houses and barns.

No one carted away Monks Mound, however. Some 100 feet high and occupying fully 15 acres of ground, this terraced behemoth was the ceremonial centerpiece of the Mississippian culture which flourished between 900 A.D. and 1400 A.D., and the only pile of dirt to be named a national historic site and be declared one of the world's cultural treasures by the United Nations. During the peak of the Mississipian occupation, Cahokia was the focal point of an urban complex of satellite towns and farming outposts which may have been home to as many as 40,000 people.

The Mississippians at Cahokia achieved a high level of civilization in an ecomony sustained by corn's primitive ancestor, maize. They lived the way civilized people everywhere tend to live. They made calendars, traded with remote peoples, suffered from a too-rich diet, dedicated beautiful artworks to the gods, organized themselves according to status, and acquired enough wealth to worry about other tribes stealing it.

The accomplishments of the Mississippians in art and social organization were unrivalled in fact except by the distant Mexican civilizations. However the culture mysteriously faded some 600 years ago, and by the time the French arrived three centuries later the Indian tribes that had taken up residence in the Mississippians' abandoned metropolis were as ignorant of them as were the puzzled Europeans. The whites did not drive the Mississippians from the Bottom, nor cheat them of it. Nor is there evidence of war or plague which might explain the sudden demise of the civilization at Cahokia. Anthropologists have been arguing the point since the 1920s. Some speculate that the cause was economic, that the population grew too large to be sustained by the local resource base perhaps, or that hostility from Late Woodland peoples disrupted trade networks.

All-American

The Indian cultures of the Bottom presaged the American one in fascinating ways. Floodplain and upland peoples sometimes coexisted in the Bottom, perhaps uneasily, each with different cultures and economic bases. In the same way, modern upland towns like Alton or Belleville are largely distinct, ethnically, politically, and economically, from lower floodplain towns like East St. Louis. As the noted sociologist Daniel Elazar observed about the Metro-East region in 1970, "It is a miniature megalopolis masquerading as part of a metropolitan area."

The differences between the occupying cultures have been more decisive in reshaping the Bottom, however, than the similarities. As Bill Woods, a geographer and archaeologist at Southern Illinois University at Edwardsville, explains, trade was never as crucial to the Indian economy as it was to the Europeans'.

Once the European economy passed from the subsistence phase to the market phase in the mid-19th century, the Bottom lived from the river less than it lived off of it. A river which is to be used must be controlled: Land which is to be built upon must be dry. Flooding was a regular occurrence until approximately 1910, when construction began on a massive system of levees, pumps, drainage canals, catchment basins, and relief wells which today keep the Bottom dry. It is a never-ending task – as Nani Bhowmik of the Illinois Water Survey emphasizes, the American Bottom is just that, a low-lying place – and performing that task has transformed the Bottom. Once wide and meandering, the Mississippi today is confined to a narrow channel; towns such as Carondelet and East St. Louis which used to be on the river today are only near it.

Cannon in Fort de Chartres

People moved through this river crossroads as well as goods, which is why so many Bottom towns are among the earliest in Illinois as well as the oldest. [illegible] trade, which had been sporadic [illegible]

(continued on p. 24)

WETLANDS: A LIVING LABORATORY

Volo Bog: State Natural Area, Lake County.

What human value could there be in soggy, wild, dangerous areas ideal only for mosquitoes, snakes and scores of other varieties of offensive plants, insects and wildlife?

"Disease–breeding wasteland" was the generic label hung on millions of acres of the nation's wetlands for more than 200 years. An agrarian society moving relentlessly west made swamps, marshes, bogs, fens and wet meadows suitable for people, their homes, their farms and pastures and, later, their cities, highways and bridges.

"The price of economic development was the destruction of 50 percent of the nation's and 90 percent of Illinois' natural wetlands – over 8.5 million acres in our state alone," according to Dr. Donald Hey, the environmental engineer who directs the Des Plaines River Wetlands Demonstration Project. "The federal government has spent billions of dollars in an attempt to clean up the nation's lakes, rivers and streams, prevent flood damage, and create wildlife habitat because our wetlands have been drained and our rivers dredged, straightened and otherwise disfigured." Dams and treatment plants have improved the condition of the nation's surface waters. But Hey intends to prove that wetlands, carefully chosen, can do a better job for less money.

From Wasteland to Wetland

Financially and philosophically supported from the beginning by the Illinois Department of Energy and Natural Resources (DENR), the demonstration project aims to create a wetland in a remote area 35 miles north of Chicago that was indeed a man–made wasteland when feasibility studies began in 1980–81.

"Along this nearly three mile stretch of the Des Plaines River, they are giving birth to a complicated, sophisticated living laboratory from which elements of a total wetlands ecological system can be identified, extracted and adapted for use elsewhere," said Karen Witter, Director of DENR.

Costing an estimated 10.2 million dollars and spanning 15 years, the project offers scientists and engineers infinite opportunities to experiment, test and study. By 1995 some 450 acres of "created" natural wetland will be returned to the Lake County Forest Preserve District for maintenance.

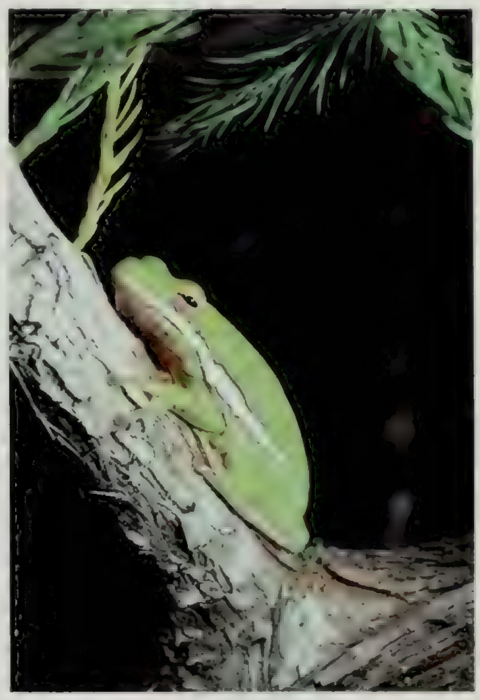
"Using public pathways, people will be able to see an almost ethereal kind of beauty. As they see it, they will better understand the natural functions of wetlands – how this fragile combination of living things existing as a buffer between land and open water serves to store floodwater, filter and cleanse surface water, recharge groundwater, and, in a very literal sense, help protect and clean the environment in which we live," Hey observed.

In Illinois there is a real commitment to protect, preserve and restore many or our original wetlands, according to Marvin E. Hubbell, Wetlands Program Administrator at the Illinois Department of Conservation (IDOC). A plan is now in the works to restore the balance between economic development and preservation of Illinois' precious wetlands. Formulation of that plan is the work of the Wetlands Advisory Committee (WAC), a group sanctioned by the Governor and funded by the General Assembly. Its members include government agencies, environmentalists, business and industrial interests.

This spring WAC intends to submit legislation aimed at strengthening, clarifying and expanding existing state and federal legislation governing the fate of wetlands. "Those we still have, those in jeopardy and those that must be reinvented. The Des Plaines River Demonstration Project will reveal many of nature's secrets," Hubbell said.

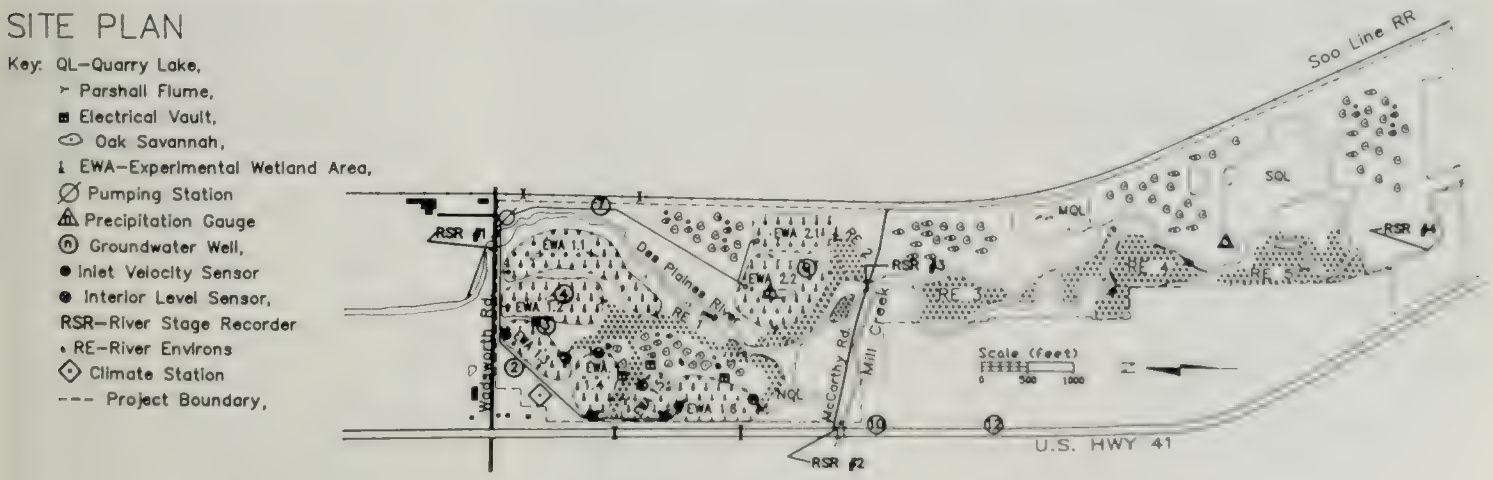
Its Infinite Variety

"From the standpoint of living things, every wetland is different from every other," noted Dr. Allison Brigham, aquatic ecologist with the Natural History Survey. Plants, trees, animals and insects that can be re–established in northern Illinois are totally unlike those thriving in the wetlands of southern Illinois. Species there are more like those found in Louisiana and Florida. "Until last year, we spent our time at Des Plaines figuring out what species had lived there scores of years ago and which ones had to be seeded and planted to begin re–creation of a balanced ecosystem," Brigham reports. "Once plant life and water are ready, mobile living creatures like birds, insects, animals and fish will again choose to use the lush, natural vegetation." For now the Natural History Survey is on hold, waiting for earthmoving and construction to be completed.



A marshy inhabitant

Scientists agree that groundwater and surface water interact in wetlands, but that interaction is different and of greater or lesser importance at every site. That's when decisions get sticky. "There are pros and cons to a wetland's value – its existence," Hey states. "In areas where human activity depends upon clean, plentiful groundwater, wetlands can serve a cleansing, recharge function. But if the priority is to secure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RSR–River Stage Recorder
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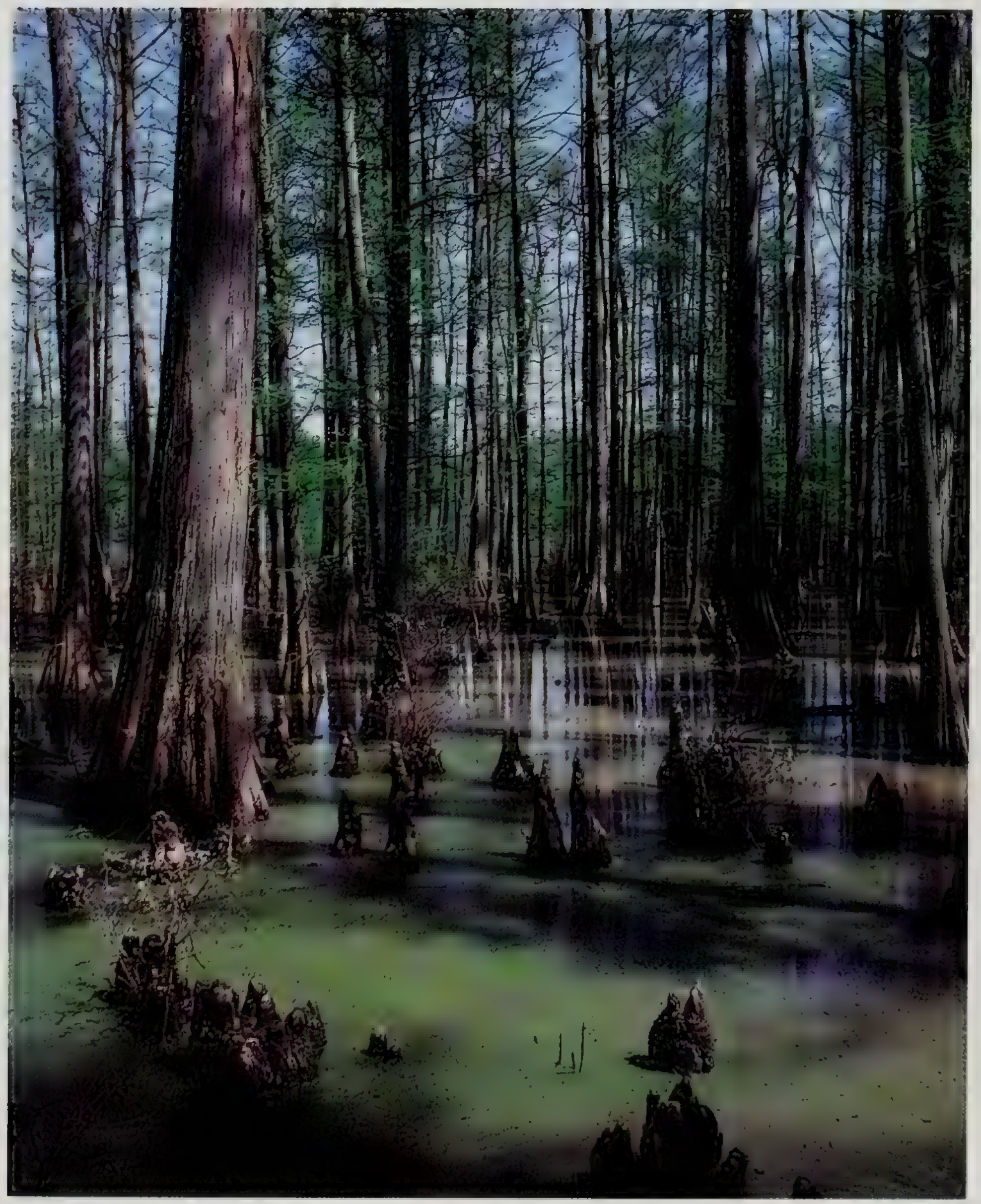
◇ Climate Station
--- Project Boundary,
Soo Line RR
SQL
MQL
NQL
RSR #1
RSR #2
RSR #3
RSR #4
EWA 1.1
EWA 1.2
EWA 1.3
EWA 1.4
EWA 1.5
EWA 1.6
EWA 2.1
EWA 2.2
RE 1
RE 2
RE 3
RE 4
RE 5
Des Plaines River
Wadsworth Rd.
McCarthy Rd.
Mill Creek
Scale (feet)
0 500 1000
N
U.S. HWY 41

Site Plan of the Des Plaines River Wetlands Demonstration



Swamp: Little Black Slough at Heron Pond in Johnson County.

more surface water and the sponge effect of a wetland is pronounced a negative, new ways must be found to compensate – to reach a balance."

Dr. Richard Berg of the Illinois Geological Survey says, "We want to know how all of this human intervention at the Des Plaines site will affect the river's shape and the materials composing the riverbed in addition to looking at the groundwater–surface water interaction." The Geological Survey has drilled 80 wells, some clustered and of varying depths, strategically placed among the bone–dry indentations on the project site. These shallow, saucer–shaped, man–made indentations became "ponds" as water from the Des Plaines was pumped into them.

Using an elaborate irrigation system dotted with all sorts of instruments, a plethora of benchmark scientific studies will occur daily. "To check the river itself," Berg said, "we've set up 28 cross–sections along the project's three–mile stretch."

Using the same wells, the Illinois Water Survey is researching the levels at which water is found and the river's water quality as it flows through a labyrinth of pipes, channels and ponds. From this labyrinth will emerge an ecologically balanced wonderland of living things, each species nurturing others as the whole system serves to cleanse land, water and air.

A Blueprint for Restoration

Linking the project's three parts – geology, water and living things – is the water cycle. "We're taking water samples from each pond to see how its quality changes from entry to exit," said Dr. Rodger Adams, hydraulic engineer with the Water Survey. "But we also need to know how nature influences the whole." At the project's climate station, scientists use sophisticated instruments to monitor soil moisture, solar radiation, temperature, wind direction and speed and precipitation.

While land–clearing, construction and seeding work await additional funding, the man–made wetland along the Des Plaines took its first breath when the pumping station opened late last October. The consensus of scientists, engineers, environmentalists and politicians seems to be that the money spent at the Des Plaines River Demonstration Project was well–spent and will show us how to rebuild natural cleansing systems, control flooding and replenish water supplies.

"What we learn here," said Project Director Hey, "will draw a basic blueprint – a model – for repairing the damage we've done to our wetlands. As scientists, engineers and students from here and abroad continue to visit the project, they are finding, as we have, that uses of this blueprint are endlessly astounding and economically sound."

For more information regarding this project please contact Dr. Donald L. Hey, Wetlands Research, Inc., 53 W. Jackson Blvd., Chicago, Il, 60604.

THE ANCIENT ONES

The Navajos called them the Anasazi, the Old Ones, the ancestors of our enemies. They lived and built in the Four Corners of the Southwest, where Colorado, Utah, Arizona and New Mexico meet, from 100 B.C. to the thirteenth century A.D. When they mysteriously disappeared, they left behind twin legacies of huge stone cliff dwellings and pottery that brings tens of thousands of dollars from avid collectors.

Master Builders

What is known about the Anasazi Indians is every bit as intriguing as what is not known about their culture. Archaeologists estimate that there are more than 100,000 Anasazi sites on the Colorado Plateau. Only a few have been excavated, only a few thousand mapped. Every site has a few things in common: dwellings placed to catch the winter sun and the summer shade, a source of water and soil good enough to grow a corn crop.

The Ancient Ones began as small groups of hunters and seed collectors who lived in pit houses roofed with canopies of brush and mud. Sometime between 0 and 500 A.D. they became part–time farmers and basket–making became prevalent. About 500 A.D they acquired a gift for making beautiful pottery, the bow and arrow, and the hafted ax. They turned to farming full time, raising corn, squash and beets. The population grew and prospered. The basketmaker era ended when they moved aboveground to community living. Their pit houses became kivas, the focal point of Anasazi ceremonial life.

The expertise of Anasazi builders was crucial to their continued development. They began to manipulate their environment, constructing shallow channels that diverted runoff onto their small fields and building check dams that collected eroded soil and held the water that carried that soil. There might be hundreds of such dams in a single community. This development proved critical in the period from 700 to 1100 A.D., when local frosts and droughts struck frequently.

From 1100 to 1300 A.D. the Anasazis began to build multi–story buildings and engage in extensive trade. The tribes living on the Mesa Verde built giant cliff dwellings, the last of the Anasazis to build complex masonry structures. Their aeries under the overhangs of cliffs were the most spectacular of all the dwellings of the Ancient Ones.

Counting Quartz Grains

In a $400,000 six–year project funded by the U.S. National Park Service, researchers from the Illinois Water Survey (IWS) worked to measure the damage done to those spectacular ruins by manmade pollutants and by nature herself.

Cliff Palace

Copyright 1988 D. [illegible]

The Sun Temple *Copyright 1983 D. Dolske*

"The real treasure of the Anasazis were the sandstone blocks they shaped and decorated themselves," explains Don Dolske, project head with the IWS. "Our job was to develop a method for measuring the erosion rate affecting the blocks, look at airborne environmental pollutants and the surrounding microclimate and relate those variables to how much damage is occurring and why."

This isn't the first time the Park Service has called on Dolske and the Water Survey. Preservation of cultural monuments has become a special talent of Dolske's. He has also been involved in measuring the effects of acid deposition on Civil War monuments at Gettysburg National Park (see the fall 1987 issue of *The Nature of Illinois*, "The Erosion of History at Gettysburg").

Dolske's team set up two test walls of five stone blocks each. The stones were selected in consultation with Mesa Verde Park archaeological personnel from rubble left by crews who had reconstructed and stabilized the existing ruins. The stones had lost their context with respect to any existing ruins and were of small archaeological value.

One wall was located on a rock ledge fully exposed to the elements and near Dolske's climate monitoring station. Twenty–five meters away, the second wall was placed at the extreme down–canyon side of Spruce Tree House Ruin, which is protected by a rock overhang. In addition, sandstone specimens cored out of a single block were mounted in quartz holders and held in acrylic racks at each site.

Using microphotography with pictures taken at one–month intervals, the rate of surface recession on the stones was measured by counting the loosened quartz grains that fell off the blocks.

Weather and atmospheric chemistry measurements were made at two towers. For each month, average levels of such pollutants as sulfate, nitrate and sulfur dioxide were taken. These pollutants are of special interest because of their involvement with the acid rain problem. Information on acid rain from the National Atmospheric Deposition Program was made available to IWS researchers. Microclimate parameters measured at Spruce Tree House included temperature, relative humidity, horizontal and vertical wind velocity, wind direction, incident solar radiation and rainfall rate.

"Our task now is to correlate all of this data to determine what impact any or all of these variables have had on recession rates, " said Dolske. "On the surface, rainfall amount appears to be the greatest factor, and that is critical because recent construction of large industrial installations like power plants and smelters in the area could alter local air chemistry and climatic conditions. We will look at what happens to the erosion rate if the amount of pollutants doubles."

"Our measurements for the first four years of our study times the 700–year age of the ruins show only one millimeter of surface erosion on the sandstone blocks. That's really not too much damage, with the present day recession rate not that different from the historical rate. One cautionary note, though. The materials in the blocks are sensitive to the pollutants involved in the acid rain problem. There is cause for concern, but no cause for alarm."

The two test walls and racks of sandstone samples will continue to be monitored for at least ten more years by Park Service personnel.

A Cultural Recession

The ruins of the Old Ones will be in place for archaeologists to puzzle over for a long time. The biggest threat to the Anasazis may not be nature or acid rain, but the pothunters and vandals who use spades, shovels and even bulldozers in their quest for black market art booty. Archaeologists will need every bit of time and every pot shard to unravel the many mysteries surrounding the Anasazis.

No one knows why the Anasazis settled on the Colorado Plateau in the first place. Most of the areas they lived in were too cold or too hot or too dry. No one knows why they built an incredibly complex series of roads when they had no wheels or pack animals. There may have been a Mexican trade connection to the very rapid development of their culture – archaeologists have found abalone shells that could only have come from the south. Most puzzling, where did the Ancient Ones disappear to and why?

Most archaeologists say that a 10 to 15 year drought and severe ecological disturbances wrought by the Anasazi themselves as they cut down trees to grow corn were the reasons the tribes dispersed to be swallowed up or annihilated by their neighbors.

Dolske has his own theory. "There were active volcanoes in this area from 1000 A.D. to 1200 A.D. Their dwellings were under overhangs that could have fallen down, or they were smoked out by volcanic debris and sulfur dioxide, or the shaking simply scared them away."

"I was extremely fortunate in seeing the ruins as a researcher instead of as a tourist. Most ruins are visible, but roped off to the public. We actually got to go inside rooms with the plaster still hanging and decorations painted on the walls still intact. In one unexcavated area we saw pot shards and old corncobs. I've gone to the ruins three times a year for the past six years. I'll be going back."

SURVEYING ILLINOIS

BIORHYTHMS

Barging In On Mussels

The Natural History Survey's Aquatic Biology Section is researching the effects of barge fleeting on mussel beds, looking specifically at present and projected increases in fleeting permit requests for the Illinois, Mississippi, and other midwestern rivers. Mussels were collected from fleeted and unfleeted areas of the Illinois River at Naples, Illinois. Scientists noted any damage to the mussel shells and engraved them with identification numbers. The mussels were also measured before being replaced in the river.

Mussels from two fleeted and unfleeted sites were recaptured annually to compare mortality, shell damage and growth rates. After one year the scientists found that mussels from fleeted areas had more shell damage, higher mortality rates and lower growth rates. Since 1984 more than 4,000 mussels have been marked and more than 500 have been recaptured. The project is scheduled to be completed this year.

The Great Mite Smoke–out

During the fall of 1987 the dreaded exotic mite *Varroa jacobsoni* was discovered for the first time in North American honey bee colonies. Fourteen states, including Illinois, have colonies infested with this external parasite. NHS scientist E. Killion, Extension Specialist in Apiculture, is collaborating with several federal agencies to develop a technique that will aid regulatory agencies and the beekeeping industry in sampling honey bee colonies for *Varroa* mites.

A sticky mite detection board has been devised that can be inserted in the bottom of a bee hive. A miticide (pesticide that kills mites) is then placed in the upper area of the hive, forcing mites to drop onto the sticky detection board. In a recent experiment a colony was smoked with a nicotine–rich tobacco. If results prove favorable, smoking may replace the miticide as a simple, quick and economical way for beekeepers to survey their colonies.

Oh, Rats!

Illinois has more rats than anyone thought. With support from the Illinois Endangered Species Board, NHS scientists recently completed a study on the distribution, abundance, and status of the marsh rice rat in southern Illinois. This small mammal is listed as a state–threatened species.

At least 85 rice rats were live–trapped in nine counties, including three counties which had not previously reported the species. These new records, in conjunction with the recent discovery of rice rats in Pope County, reveal that the species is more widely distributed in Illinois than previously thought.

However the rats' habitat is a type of wetland, which exists mostly as small isolated patches that cannot support large populations. The rice rat will remain on Illinois' threatened and endangered species list.

Illinois' endangered Marsh Rice Rat
Photograph by J. Hofmann

CURRENTS

Look Out For Lightning

A recent study shows lightning strikes more often than previously thought, as seen in this photograph. Copyright 1988: Mark F. Raeber

Electrical storms may be more dangerous than thought according to a study of lightning conducted in part by Water Survey scientist Stanley Changnon. Changnon used sensitive equipment to record the number of lightning bolts which touched ground.

His findings show that lightning strikes more frequently than weather records have shown. This discrepancy is probably because record keepers are trained observers who listen for thunder, which was thought to always follow lightning.

However the study shows that between 22 and 40 percent of lightning bolts are "silent"—not accompanied by thunder. This could have adverse implications for businesses like nuclear power plants, which have had to base risk analyses on old, conservative reports

Do Agricultural Chemicals Affect Groundwater?

Each year millions of pounds of agricultural chemicals are applied to Illinois fields. The Water and Geological Surveys have begun the first phase of a comprehensive plan to determine how these chemicals may affect the groundwater quality of rural private water supplies.

The pilot study will establish the methods and procedures to be used in a statewide assessment of the effects of fertilizers, herbicides and insecticides. Researchers will collect water samples from wells in areas thought to be at risk from agricultural chemical contamination. Different levels of risk were developed by evaluating near–surface and aquifer materials, aquifer depth and the amount and kinds of pesticides in use.

During the plan's second phase researchers will conduct the statewide assessment, with the third phase calling for establishment of a long–term statewide monitoring program to ascertain if problems are local or widespread.

The Drought Continues....

Although the fall brought rainfalls and thunderstorms to some parts of Illinois the drought isn't over. This fall, parts of the state were two to fourteen inches below the yearly average precipitation level. Water Survey scientists say that there's less than a 10 percent chance of recovering lost precipitation by next April.

They also say that the state's water supplies could reach critically low levels due to the drought, which they've labelled as worse than the droughts of the 1930s and 1950s. The levels of some rivers and streams hit record lows this summer, and fall foliage was duller and shorter–lived due to dry conditions.

According to a Survey report the drought won't be over "until renewed and sustained precipitation has begun to fall over relatively large areas of the state and continues." And the drought's effects won't cease until six to eight weeks after that.

CENTERING ON WASTE

Household Hazardous Waste Education

How many of us have old pesticides, paint solvents, or other household chemicals sitting around the house? How many of us know how to properly dispose of these household hazardous wastes? A recent household hazardous waste collection day along with resident surveys conducted in Champaign shed some insight into the public's knowledge of hazardous wastes.

Last year Champaign area residents were invited to dispose of their household hazardous wastes for free in a day–long program sponsored by the Intergovernmental Solid Waste Disposal Association of Champaign, the City of Urbana and Champaign County. Surveys conducted before and after the collection day show that public awareness about hazardous waste problems increased between 20 to 30 percent because of the event, which helped dispose of seven percent of the amount of hazardous wastes improperly disposed of each year.

Farmers participating in the survey averaged 26 partial or full containers of hazardous material while urban households averaged 10 containers. Far–ranging educational programs are needed to reduce household production of hazardous waste. Copies of this report are available from the Hazardous Waste Research and Information Center (HWRIC) at (217) 333–8940.

Hazardous Waste Reduction Plans Wanted

To encourage industry to reduce the amount and toxicity of wastes it generates, the HWRIC has begun a Recycling and Reduction Techniques program which will help fund innovative hazardous waste reduction methods. Under the program Illinois businesses, industries, public and private researchers, consultants and vendors in the hazardous waste field can apply for funds up to $50,000.

The matching funds are awarded to applicants whose projects have strong potential for developing practical waste minimization techniques that Illinois industries can use. Up to $50,000 is given for large research projects and between $5,000 and $10,000 is given for smaller projects such as waste reduction audits.

The grants could save Illinois industries millions of dollars by reducing costs associated with hazardous waste disposal. Eligible projects include those that: test equipment to reduce, detoxify or recycle waste streams, reclaim or recycle hazardous wastes on– or off–site, minimize the amount of hazardous waste generated, or achieve a high degree of innovation in hazardous waste treatment. For more information, call the HWRIC at (217)333–8940.

HWRIC Helps Train Industry

Through the HWRIC and the Illinois EPA, Illinois was one of ten states selected for a national waste reduction training program funded by the U.S. Environmental Protection Agency. The Resource Conservation and Recovery Act Integrated Training and Technical Assistance Initiative (RITTA) program will help train personnel from the regulatory, technical assistance, and business/industry community in hazardous waste reduction and waste minimization.

HWRIC'S involvement in this program will benefit industry by providing interns to help work on waste reduction and recycling projects and by providing generators with information on how they can better manage and reduce the waste they are generating. Using this assistance, participating industries' productivity and efficiency should increase, while the amount of waste they release into the environment should decrease.

GEOGRAMS

There's Oil In Them Thar Valleys

A network of 300 million year old valleys lies buried only 1,000 feet below the surface of Illinois. When the valleys were drowned by rising seas 300 million years ago, porous sandbars along the valley floors were buried by impermeable marine mud, creating the potential for petroleum traps. Until recently little public information existed on the petroleum trapped there.

The Geological Survey recently issued "Illinois Petroleum 129," the first report to discuss one such trap in detail. In this report, geologists R. H. Howard and S. T. Whitaker discuss the accidental discovery of a petroleum trap near Hardinville in 1955 and the reasons geologists overlooked the existence and importance of that buried valley for 20 years.

Luckily the same sandbar was again encountered in 1974 one and a half miles from the original oil–bearing sand. Within that one–and–a–half–mile area, 20 producing wells were subsequently drilled. With this study as a guide, explorationists can make a deliberate attempt at finding other such reservoirs throughout significant portions of the state.

Survey Produces National Heritage Corridor Brochure And Study

The Illinois–Michigan Canal was directly responsible for the growth of Chicago as a market and processing center and for the settlement and development of northeastern Illinois. In 1984 Congress created the Illinois–Michigan Canal National Heritage Corridor, a new kind of national park which directs attention to the canal area's geology, archaeology, pre–history, settlement and industrial development.

After Congress established the Corridor, the National Park Service (NPS) contracted with the Geological Survey to produce a geological inventory of the Corridor. The Survey covered the immediate canal, the river valleys, the adjacent uplands and other important nearby sites. The study included geological bedrock and surficial geology maps of the I & M Corridor, and geological sites of special significance for historical, tourist, scientific or commercial interest.

These studies resulted in a document on the geology of the corridor for the NPS and a new color brochure about the canal area called "Ice Age Geology." (The Society will mail a brochure to all Society members in the near future.)

Personnel Notes

Chief M. W. Leighton presented the "Distinguished Achievement Award for Fiscal Year 1988" to Dr. John P. Kempton, senior geologist and special projects leader for the Survey's Superconducting Super Collider (SSC) Task Force.

During his 32 years with the Survey Kempton led the initial geological studies to successfully site the Fermi National Accelerator Laboratory in Illinois, and led the Northeastern Illinois Planning Commission Task Force and the SSC Geological Task Force. Kempton has also served as acting Group Head for the General and Environmental Geology Group, developed a ground-water research program to seek additional water resources for Danville, and participated in the beginning of a geology–for–planning study for Logan County.

Robert A. Bauer, geologist and supervisor of the Rock Mechanics Laboratory, was named the Douglas Piteau Outstanding Young Member of the Association of Engineering Geologists. Bauer has received international recognition for his achievements related to his work on the SSC, the Illinois Mine Subsidence Research Program (IMSRP) and other projects.

SHORT TAKES

The Cave State

Illinois is known for its prairies, not its caves. But a recent study of the state's caves shows that Illinois houses 480 of them, or four times more than previously thought. The bad news is that of the 84 caves which were extensively inventoried, 61 percent showed signs of human damage, some significant enough to render the cave "dead."

Spelunker repelling into a Hardin County cave
Photograph by James Oliver

Several years ago the General Assembly passed legislation protecting caves and their resources, which often include endangered and rare species and important archaeological remains. However, no one was really sure how many caves Illinois had, where they were, or what they contained. The Illinois State Museum conducted a study to gather this data and use it to help preserve the caves.

Of the 84 caves investigated, most are privately owned in rural areas (many in southern Illinois), more than half contain streams, nearly one–fifth have rare or unique formations, and some house endangered bats and other invertebrates unique to Illinois. But don't plan on visiting any of these caves. Museum paleontologist Russ Graham says the caves' locations will be kept largely confidential to prevent further human damage

Agency Nurtures New Generation Of Conservationists

Kids for Conservation charter members as they appeared on "Good Morning America" during the 1988 Illinois State Fair. Photograph: Illinois Department of Conservation

Forget the Nintendos and G.I. Joes, today's kids will use their spare time to become conservationists under a new program created by the Illinois Department of Conservation (DOC). "Kids for Conservation" is a free club for Illinois youngsters up to 16 years old.

DOC spokeswoman Glenda Burke says the department saw a need to make parents and children more environmentally conscious and thought the best way to reach both groups would be through an at–home club. Club members will receive a quarterly conservation magazine and can participate in upcoming special DOC–sponsored events that will be held statewide. Fifteen thousand children are currently enrolled in the club and DOC hopes to register thousands more.

The Radon Scare

This fall the U.S. Environmental Protection Agency released a report saying that radon, a radioactive gas produced from decaying uranium in the soil, was found in high concentrations in homes in seven states. Lengthy exposure to higher levels of radon is believed to promote lung cancer. While radon is a significant problem, a spokesman for the Illinois Department of Nuclear Safety (DNS), says that Illinois has average radon levels, with no areas showing exceptionally high readings.

A recent DNS study of Illinois homes shows that 43 percent have radon readings above the recommended levels and one percent have readings above the action level. The department recommends that persons test the radon levels in their dwellings if they suspect high levels. Radon is a colorless, odorless gas that seeps into homes through cracks and often exists in basements or groundfloors.

Home test kits are available at hardware and grocery stores. By calling (217) 786–6024 you can get a DNS–published list of reputable detection businesses, their prices and services. Radon can be removed by contractors or by homeowners.

When The Sky Runs Out...

It's time to get serious about ozone, according to scientists from the U.S. Environmental Protection Agency (EPA). Recent EPA studies show that chlorofluorocarbons (CFCs) may have destroyed more ozone than originally thought. Ozone is essential in our atmosphere because it protects plants and humans from the sun's ultraviolet light, which, in large amounts, could kill plant life and cause other unknown damage.

The EPA is urging countries to stop using CFCs which are often found in aerosols, air–conditioning and insulating foams. Last year about 40 countries signed a treaty vowing to reduce CFC production in the next decade. Some scientists worry that it's too little too late. In fact there's a hole in Antarctica's ozone layer every spring that seems to last longer each year. Canadian researchers now think the Arctic is also developing an ozone hole. Additionally, it will take one or two centuries after we've stopped using all CFCs before the atmosphere can naturally heal itself.

To Burn Or Not To Burn?

This summer's devastating fires in Yellowstone Park have made some people question the National Park Service's 16–year–old fire policy. The Park Service allows some naturally–caused fires to burn (while being closely monitored), while the U.S. Forest Service tries to extinguish nearly all fires. (Those Yellowstone fires started by humans this summer were fought immediately.)

The Park Service's approach is that burns should be allowed so that forests follow their ecological cycles. This philosophy says that forests are reborn when fires clear out dead growth, thus nurturing new plant and animal life.

This policy also let quantities of dead growth accumulate and made the forests ripe for fires. Additionally, circumstances surrounding this summer's fires were unusual because Yellowstone had experienced its worst drought in more than a century.

Scientists are still debating whether we should interfere with forest cycles or not.

First Nuclear Waste Repository Postponed

Concerns about the safety of the nation's first permanent repository for high–level nuclear wastes prompted U.S. Department of Energy officials to indefinitely postpone its opening. The $700 million New Mexico facility would collect large amounts of radioactive, plutonium–contaminated wastes accumulated from years of atomic weapons production.

Some officials feared that the facility, a series of long corridors, large storage rooms, and ventilation shafts 2,150 feet underground, could not operate safely. The facility was scheduled to open in October, but is not likely to open until this year or later, after safety questions are answered.

Cleaner Living Through Corn

The city of Urbana is going to use degradable plastic bags made partially of cornstarch to get rid of its yard waste. The Illinois Department of Energy and Natural Resources (ENR) gave the city a grant to test the bags, which will be secured with natural brush ties.

Officials from ENR say if the test is successful it could help reduce dependence on community landfills, offer safe alternatives to leaf burning, and promote another use for Illinois corn. The project will also demonstrate that the bags and ties help process yard waste into usable garden mulches and ornamental wood.

Where Are The Ducks?

This is a bad time for ducks, according to Dr. Frank Bellrose, a waterfowl specialist with the Illinois Natural History Survey who has studied ducks for five decades. Duck populations have declined in recent years due to droughts and a loss of the wetlands that ducks use as breeding grounds.

The wetlands were drained for agricultural uses or dried up naturally due to droughts. When ducks could find sparse nesting areas, the lack of vast breeding grounds left their nests open to more predators.

Scientists think the ducks can recover. To help them, many conservation groups are calling for the reclamation of Canadian and North American wetlands under a joint program by the U.S. and Canadian Wildlife Services...but the price tag is one billion dollars.

Some of Illinois' duck populations which are threatened by the loss of wetlands.

Raising Raptor Consciousness

Raptors such as hawks, owls, bald eagles, and peregrine falcons are at the top of the food chain. They are very sensitive to environmental changes and were hurt by the DDT pesticide and other pollutants. Since raptors have low reproductive rates and many are endangered species, the Illinois Department of Conservation has developed programs to monitor their populations, protect their habitats and increase public knowledge about their importance.

Along with such programs as "Don't Shoot Hawks and Owls" and "Bald Eagle Appreciation Days," the department is coordinating a Midwest Raptors Symposium from February 27 through March 1 in Chicago. The symposium, whose co–sponsors include the Illinois Natural History Survey and the Society for the Illinois Scientific Surveys, will address raptor population status, habitat requirements, mortality causes, monitoring techniques, management practices and public education.

Illinois' raptors, like this hawk, are essential to maintaining stable food chains.
Photograph: Joe Milosevich

MUSEUM MOMENTS

The following is a calendar of events at the State of Illinois Art Gallery in Chicago and the Dickson Mounds Museum.

State Of Illinois Art Gallery

January 17 – March 10
Don Baum: Domus exhibit

March 20 – May 12
Photography Illinois exhibit

May 22 – July 7
Contemporary Puerto Rican Artists

Dickson Mounds Museum

January 15, 2:00 p.m.
Harvesting the River: Life and Work on the Illinois River

January 29, 2:00 p.m.
B'rrr–owing in Winter: Animal Survival in Illinois

February 12, 10:00 a.m. to 4:00 p.m.
Artifact and Fossil Identification Day

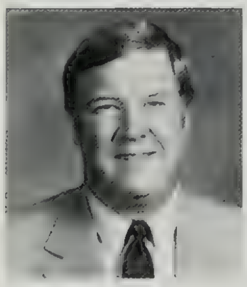
February 25, 2:00 p.m.
Rumpelstiltskin

March 11, 10:00 a.m. to 4:00 p.m.
Spoon River Wild Turkey Festival

April 2, 2:00 p.m.
Aztalan: Why Did those Mississippians Move to Wisconsin?

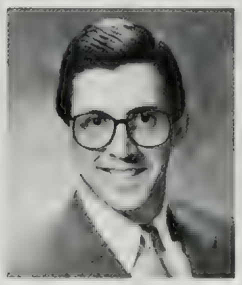
TRANSITIONS

Four Elected To Society Board


Michael O. Gibson

Stephen C. Mitchell

James D. Nowlan


John R. Doxsie

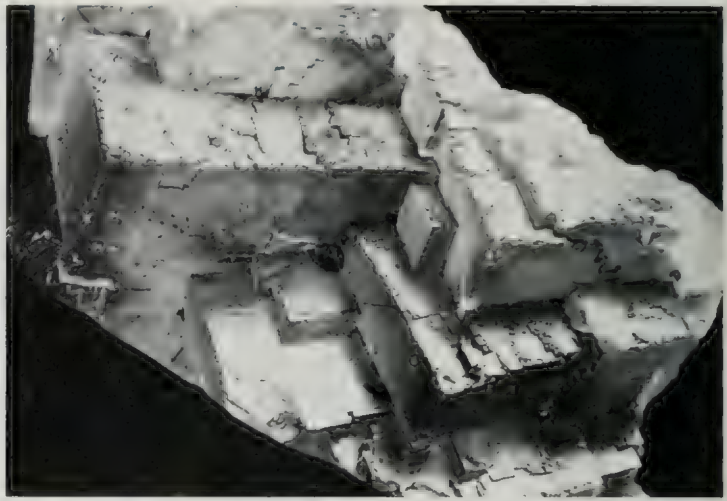
At the September, 1988 meeting of the Society's Board, Michael O. Gibson, Springfield Marine Bank Senior Vice President, was elected Board member and Treasurer. "His years of experience in trust and asset management bring an entirely new viewpoint to Society leadership," said Gaylord Donnelley, Society Chairman. Also elected to the Board were John R. Doxsie, Vice President of Decatur–based A.E. Staley Manufacturing Company; Stephen C. Mitchell, Executive Vice President of the Chicago–based engineering firm, Lester B. Knight & Associates; and James D. Nowlan, Professor of Public Policy at Knox College in Galesburg, Illinois. "We are honored indeed that men of such vision and stature see value and purpose in what the Society is about," Donnelley said.

Witter In Charge At DENR

Karen Witter has been appointed Director of the Illinois Department of Energy and Natural Resources by Governor James R. Thompson. A former assistant to the Governor for natural resource issues, Witter succeeds Don Etchison, who now manages a consulting group headquartered in Vancouver, British Columbia.

Karen Witter

TOMORROW'S MINERAL


A yellow, cubic–shaped fluorite specimen. Photograph by Marlin Roos, Illinois State Museum

Thanks to Illinois your smile is probably brighter, your sink is shinier, and your picnics are bug–free. More specifically this thanks should go to Illinois' official state mineral, fluorite. Illinois has world–class deposits of this beautiful ore which have made it the nation's top fluorspar producer. (While fluorite technically refers to the mineral and fluorspar refers to the ore containing the mineral, the terms are virtually interchangeable.)

This unsung hero of Illinois' minerals is typically formed in cubic–shaped crystals which can be colorless, white, purple, pink, blue, green, yellow, or tan. Because of its colorful variations and interesting shapes, fluorite is a popular collector's mineral. Two thousand years ago wealthy Romans considered fluorspar goblets treasures.

Indians are the first known users of domestic fluorspar, using it to carve ornamental figures and images. The first recorded use of fluorite, which is composed of nearly equal parts of calcium and fluorine, was in 1823 when hydrofluoric acid was made from Shawneetown minerals.

That was an isolated incident, since fluorspar had very limited uses in the 1830s. When southern Illinois miners were drilling for lead and found fluorspar, they threw it out on the poor–rock piles. After the Civil War ended the demand for lead decreased, and after 1870 fluorspar gradually gained popularity as a useful mineral. This popularity was secured when steel producers started using open–hearth furnaces where fluorspar was used to help cleanse the steel of sulfur and phosphorus.

Large scale production of fluorspar didn't begin until 1911 when fluorspar's popularity and demand dramatically increased due to a booming steel industry and the birth of ceramic and chemical industries which use fluorspar for a variety of products.

Today the chemical industry is the greatest consumer of fluorspar, which is used to produce hydrofluoric acid which, in turn, is used to create a dazzling variety of products: aluminum, nuclear power, chemicals, uranium, drugs, rocket fuels and other types of fluorides. These fluorides are then used to make toothpastes, optical lenses, plastics, refrigerants, non–stick coatings, fire extinguishers, anesthetics, insecticides, cleaning solvents, space guidance systems and foaming agents, among other materials.

Mining Fluorspar

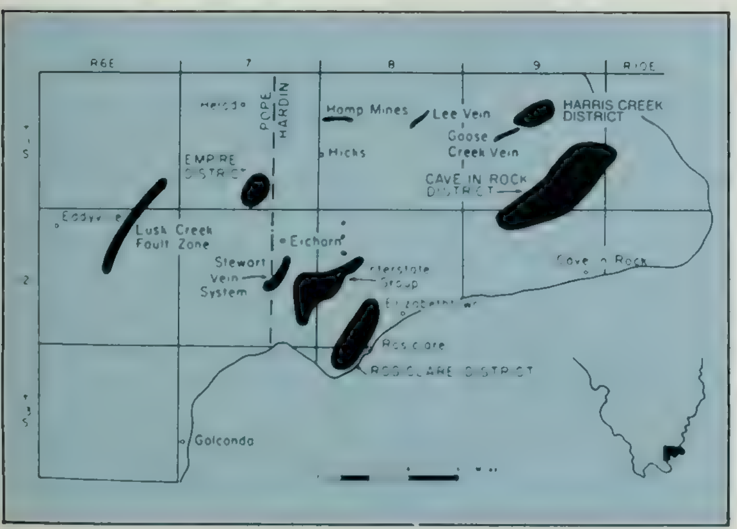
The iron and steel industry still uses a great amount of fluorspar as a fluxing agent, and the ceramics industry uses the mineral to help make glass and enamel coatings. Fluorspar is also used to fluoridate our drinking water to help prevent tooth decay and, in one of its more unpopular uses, it fuels the spray in aerosols. Fluorocarbon propellants are used to propel astronauts walking in space.

In its natural state fluorspar is found primarily underground in pockets of compact bodies of interlocking crystals. There are basically three types of these bodies or deposits: vein deposits, bedded deposits, and mixed deposits.

Vein deposits are steeply inclined fluorspar beds that "fill" vertical fissures or faults which have broken and slipped against each other.

The bedded, replacement deposits are flat, horizontal bodies of ore that lie parallel to the beds of limestone which helped form them. These deposits occur along minor faults which haven't moved much and therefore left little space for the ore–forming solutions to fill. These solutions were forced to spread out laterally along the limestone beds. Scientists think that the intimate contact between the mineralizing solutions and the limestone caused fluorite to form and actually replace the limestone.

Room and pillar mining of a bedded–replacement fluorite deposit in Hardin County. Photograph: Illinois State Geological Survey



Illinois' fluorite district and former producing mines Photograph: Illinois State Geological Survey

A final type of deposit, the mixed deposit, is a combination of the vein and bedded deposits. It usually features a narrow vein with one or more small bedded deposits spreading out horizontally where the vein intersects limestone beds.

Scientists aren't sure exactly how fluorspar formed. They think that between 290 and 100 million years ago hot brine solutions carrying fluorine and other elements were propelled by heat from igneous sources deep within the earth. This forced the solutions upward along faults and fissures where they left ore elements in compatible areas.

Some fluorspar deposits were exposed on hillsides or other weathered areas and were easily mined from open, surface pits. But these reserves were quickly exhausted and today all mining occurs underground in vein or bedded deposits.

Only two relatively new mines are producing fluorspar in Illinois. (During fluorspar's heyday as many as 11 mines were excavated.) Today's mines are located in the Harris Creek mining district and are owned by the Ozark–Mahoning Company which, as the only remaining domestic fluorspar producer, supplies 10 percent of the fluorspar used in the United States. This "spar" is used primarily to produce hydrofluoric acid which helps make medicines, refrigeration gas, and pharmaceuticals.

Finding Fluorspar

Mining is probably one of the easier aspects of producing fluorspar. The most difficult may be finding it. Geologists and mining companies are like Sherlock Holmes searching for the elusive, underground deposits that leave few clues to their whereabouts. Instead of a magnifying glass these geological detectives use various exploration methods to hunt their prey over vast expanses of land.

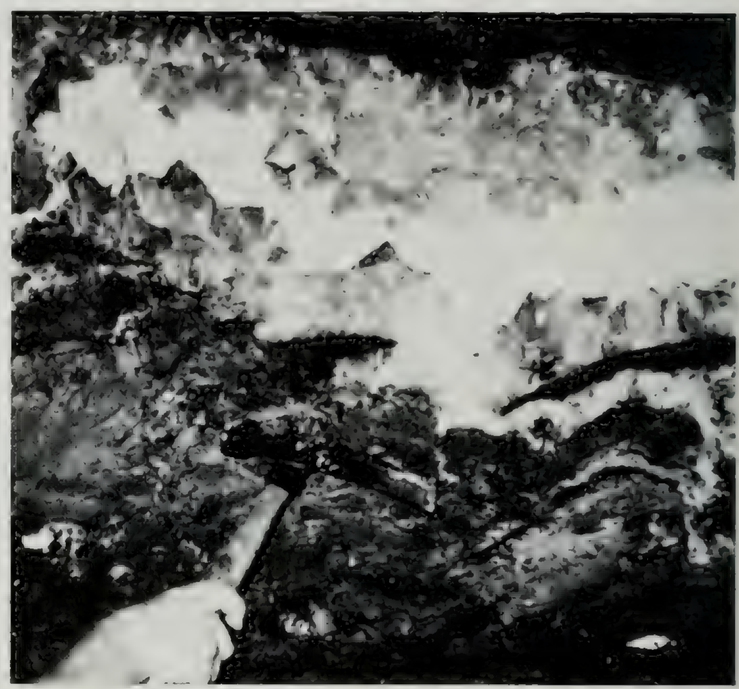
The Illinois Geological Survey is involved in some exploratory programs that will help determine if new fluorspar reserves exist or if known reserves can be extended. According to James Eidel, head of the Mineral Resources Group at the Survey, the Survey has been investigating the fastest geochemical method to search for these mineral resources, called the insoluble residue program. In this one–of–a–kind process, certain subsurface rocks are dissolved in acid and the parts which don't dissolve are examined for 31 elements. These small metal amounts, when compared to amounts from other subsurface rock samples, give clues about where to explore for potential deposits.

The Survey also used this process in conjunction with another exploratory program called CUSMAP, or the Conterminous U.S. Mineral Assessment Program. Currently a quadrangle covering 7,500 miles in southern Illinois is being surveyed. Preliminary studies of this area, which extends into Missouri, Kentucky, and Indiana, show that it may contain fluorspar, lead, zinc, and some rare metals.

Eidel says that geologists and mining companies use other exploratory methods including photogeology in which pairs of aerial photographs are inspected with a special viewer. This produces a three–dimensional picture that emphasizes the land's surface features. Various geochemical techniques are also popular in hunting mineral resources, some involving examination of minerals within streams that might give clues about hidden deposits. No matter what technique they use, geologists must eventually drill suspected deposit areas to discover if their deductions are correct.

Fluorspar's Future

What does the future hold for Illinois fluorspar? In the past several years the industry has had to combat strong import competition, stagnant fluorspar prices, increased production prices, decreased domestic demand and resulting production declines. In fact the concentration of fluorspar production in southern Illinois has further increased the costs of transporting the mineral to consumption centers. Illinois mine profits often came from the sale of minerals recovered with fluorspar–sphalerite (zinc ore), barite and silver.



Close–up of working face of ore showing fluorite, barite (white), and associated minerals. Photograph: Illinois State Geological Survey

Meanwhile other countries, including South Africa, China, and Mexico, have supplied 90 percent of the United States' fluorspar needs (which has caused the federal government to make fluorspar a stockpiled, critical commodity since so much of the country's needs are met by imports). Imported fluorspar is often cheaper than domestic because of lower production costs due to cheaper labor and larger reserves.

Suggestions to help this industry vary. S.B. Bhagwat, a Survey scientist, describes an antidote to the seemingly bleak future of America's fluorspar industry. "The future of the U.S. fluorspar industry can only be secured in a limited sense through a multi–faceted strategy that encourages exploration, improves mine productivity, revitalizes steel and other basic industries, and develops new uses for this ancient, industrial mineral."

There's hope, according to Eidel, who says Illinois hasn't exhausted its fluorspar reserves. Based on the results from some of the Survey's previously mentioned studies, he says he'd be "very surprised if there weren't other major fluorspar bodies that are hidden in Illinois."

Finally, Eric Livingston, Geologist for the Ozark–Mahoning Company, says the industry may get a boost from research currently being conducted on fluorine. While fluorspar isn't experiencing the heyday it once had, further research and exploration could yield new deposits to revive this declining domestic industry.

THE WINTER OF THEIR CONTENT

Winter scene

Long before the snow flies, before fall catalogs jam mailboxes, before screens go down and storm windows go up, the animal kingdom is abuzz with activity preparing for...inactivity.

If you've always wondered where the critters go during Illinois' harsh winters – and what they do when they get there – we herewith present a survey of the cold weather lifestyles of the furry and the fleet. They may not have central heating, but they also don't have to worry about snowblowers, that fourth pair of lost gloves or jump–starting anything.

Sleeping In

Dozing through the coldest months is one mammalian method for beating the winter blues. Hibernation occurs in degrees, but generally involves an inactive state in which the rate of metabolism, including heart and respiration rates and body temperature, is greatly lowered.

The ability of mammals to regulate their internal temperatures started as long as 150 million years ago, as they developed from their reptilian ancestors. Both mammals and birds have very high body temperatures, averaging a little less than 100 degrees Fahrenheit in mammals and three or four degrees higher in birds. One theory holds that mammals must be able to cool themselves in warm environments and keep warm in cold ones, and that the mammalian body temperature is set high because it is easier to remain hot than it is to stay cool.

Hibernating mammals abandon their warm–blooded state and sink into a deep sleep in which their body temperatures drop to match that of their burrows or caves, a few degrees above freezing. Metabolism may be reduced more than fifty–fold.

Of the eighteen orders of mammals, five contain species that hibernate. The only true mammalian hibernators found in Illinois – those whose body temperature drops appreciably – are some species of bats, the 13–lined ground squirrel, Franklin's ground squirrel, the woodchuck and the meadow jumping mouse.

In late October, when the amount of daylight has decreased, and days and nights turn frosty, the woodchuck becomes less active aboveground. It soon enters its burrow and falls into the deep sleep of the true hibernator, with heart and respiration rates only one–tenth as fast as normal. If a warm spell occurs, the woodchuck may arouse enough to leave its burrow for a food foray.

The 13–lined ground squirrel begins to put on body fat in summer and enters hibernation with double its body weight. Like the woodchuck, it grows sluggish as fall approaches and days grow shorter. By the time snow covers the ground, it has sealed its burrow entrance from within and retired to a hibernating cell just large enough for the animal and its nest. It rolls up into a ball with its nose tucked against its belly near its hind legs and goes into a deep sleep. Unable to regulate its temperature now, it runs the danger of dying if the temperature of its cell falls below freezing.

The bat population of Illinois is divided into two groups: species that migrate and species that hibernate. Those that hibernate or at least remain inactive over long periods of time are more gregarious than their traveling brothers. They live and hibernate in colonies in caves or abandoned mines in the winter and may hang in clusters. These include the little brown bat, the Southeastern, Keen's and Indiana bat, the Eastern pipistrel, the big brown bat and the Southeastern big–eared bat.

Leopard frog before winter dig–in

Hiding Out

"Contrary to popular belief, bears do not hibernate," explains Dr. Glen Sanderson of the Illinois Natural History Survey (NHS). "They're in their dens half–awake. We don't know why some species hibernate and others don't. But many Illinois species that don't hibernate can remain inactive for long periods of time when the weather is very cold. Skunks in northern Illinois will stay underground for long periods of time. Raccoons in northern states will den up together, 20 to 30 in a group, to conserve body heat. They won't eat, but they do need water, and once a week they'll go outside and eat snow or lick ice. When it's warm, both raccoons and opossums will feed at night."

Many Illinois species follow the bear's example, digging in and slowing down during the colder months to conserve energy: the opossum, raccoon, skunk, badger, fox squirrel, gray squirrel, red squirrel, and chipmunk.

Other mammals remain active throughout the year, but go to ground in cold weather: the moles, shrews, some mice, rabbits and gophers. The Plains pocket gopher, with a burrow system several hundred feet long and occupied by only one individual, lives continuously underground and comes to the surface only to dump earth from its burrow or make food forays. Shrews and mice will burrow under snow, as will prairie chickens if the snow is of the right consistency.

Storing food is another important cold weather coping mechanism used by

Bobcat in winter

shrews, squirrels, chipmunks, mice, voles and beavers. Buds, seeds and acorns are carefully cached by the gray squirrel, once called the "migratory squirrel." Ample harvests of acorns at one time resulted in a bumper crop of gray squirrels. This was followed by a nut crop failure and the subsequent mass migration of the squirrel across the country.

Sharing a habitat similar to that of the gray squirrel, the fox squirrel collects nuts for winter use, which he then buries individually in small pits dug in the ground. When nourishment is needed, the fox squirrel literally smells out its food reserves.

Unsociable and shy, the eastern chipmunk has large cheek pouches in which to carry food for winter storage. Its burrow may be twenty feet long and have several storage chambers in addition to its nest. Unlike many other mammals it does not add winter body fat, but retires to one of its various pantries when in need of food.

There are other adaptations to cold weather by Illinois mammals. Nearly all of them have winter coats that are much thicker and with longer fur than their summer coats. Some mammals change color in the winter. The least and long–tailed weasels and the white–tailed jackrabbits all turn white in winter. Deer may move from summer to winter habitats as far away as 40–75 miles, spending warm weather scattered through croplands and open habitats, but moving to dense woodlots protected from the wind in late January and February.

Leaving Town

Some bird and bat species take extreme measures to get away from the cold – they leave town. Most gray bats, and almost all silver–haired, hoary, red and evening bats migrate south in winter, usually south of Illinois but still within the United States.

"As far as Illinois' bird populations go, generally the seed–eaters stay and the insect–eaters go," says David Bohlen, Assistant Curator for Zoology at the Illinois State Museum. "Most warblers, vireos, tanagers and orioles head for Central and South America. They need insects to feed on. Cardinals, chickadees and tufted titmouses are examples of birds that stay. Generally the ones that stay can exploit seed crops, fruit or even birdfeeders. In some cases members of the same species stay in Illinois, while others will migrate."

Young raccoons in late fall

"Waterfowl will stay if they can find open water with fish to feed on. Eagles choose areas protected from the wind for winter roosts. And many birds take shelter in evergreens, which offer good protection from cold winds."

Birds like the killdeer, phoebe and eastern bluebird travel to the southern United States; some bluebirds stay in southern Illinois. Many robins head to Mexico. Cedar waxwings go wherever the fruit is. And some birds, like Illinois' golden plover, may fly as far as 6,000 miles to islands in the south Pacific, with South America as an alternate destination.

Peak migration periods occur from September through the end of October, although the orchard oriole is the proverbial early bird, heading south at the end of July. The trigger for birds' migratory activity is generally thought to be day length, although weather is also a factor.

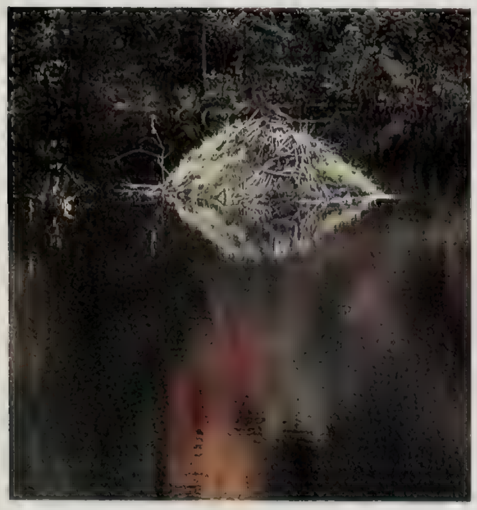
The how of bird migration is understood as little as the where and why. Some birds navigate by the sun, some by the stars, some by both. The latest research shows that magnetic fields in the earth play an important role. The recent discovery of a small metal plate in the bobolink's head may explain why that bird can navigate its way past the equator.

Lying Low

Freshwater fishes are remarkably well equipped to survive winter. The freezing point of their body fluids is about .5 degrees Centigrade below the freezing point of fresh water, and therefore they are in little danger of freezing. Streams in Illinois freeze at the surface once the air temperature drops to 0 degrees Centigrade, but water below the surface continues to flow and to provide suitable habitat for fishes throughout the winter.

Canada geese on frozen lake

According to Dr. Larry Page, ichthyologist at the NHS, fishes move from shallow to deep areas and from small to larger streams as winter ensues. These migrations enable fish to avoid freezing water in shallow areas and, by moving to quieter, deeper water, to reduce the energy necessary to maintain themselves. They are less active during the winter and need to consume less food. Only in shallow lakes which freeze to the bottom in severe winter are they likely to freeze.



Beaver lodge in fall

According to Dr. Mike Morris, an ichthyologist with the NHS and herpetologist on his own time, snakes, turtles and frogs also go into a winter state where their metabolic rate is very low. Turtles actively excavate riverbanks for burrows, while snakes look for existing holes, usually the burrows of mammals, to shelter in. They all have one thing in common: they must go below the frost line. Some frogs and turtles shelter in lake bottoms, again where their metabolic rates decrease, with frogs breathing through their skins and turtles through their mouths and anuses. You can still find snakes above ground in midwinter if you want to – they'll be out on the rocks, sunning themselves. And salamanders are very cold–adapted, breeding even with ice on the ponds.

"One of the best known hibernacula in the country is located in southern Illinois," reports Dr. Morris. "Little Grand Canyon in Jackson County, 10 miles southwest of Murphysboro, is the best known snake den in the country. There used to be hundreds and hundreds of snakes there, including rattlesnakes and cottonmouths. Unfortunately, it became a little too well known. People came to shoot the snakes for sport. There are considerably fewer snakes hibernating there now."

Biologists have come a long way in understanding the who, what, when, where and why of animal survival during winter, although most maintain there is much more research to be done. Consider this: Aristotle and his contemporaries believed that the disappearance of birds at wintertime was caused by robins and redstarts changing into one another (one was believed to be a winter bird, one a summer bird). They also believed that masses of swallows spent their winters beneath the surface of pools in tight balls to escape predators.

Imagine what Aristotle could do with bears.

ILLINOIS IN CAMERA

by James Krohe, Jr.

ole Farm
hotography: Larry Kanfer

"When people see my scenes from Horsehoe Lake they say, 'I didn't know we had cypress swamps in Illinois,' " explains nature photographer Willard Clay. "And it's true that those scenes don't look much like Illinois." The magic of a good photograph, however, is its ability to reveal things we may have looked at a hundred times but have never really seen. And few landscapes are as little seen as Illinois'. The prosaic charms of its agricultural expanse are seldom appreciated, its surviving pristine wonders – tucked into the far corners of the state and in a few river valleys in between – are seldom visited.

A dramatically different Illinois is revealed in three handsome books of landscape and nature photographs now in bookstores. The publication in 1987 of Larry Kanfer's collection, *Prairiescapes*, announced a renewed interest in art photos of the Illinois landscape. Since then two new collections have been released – *Illinois* by Gary Irving and *Illinois: Images of the Landscape* by Willard Clay.

Each of these books is generously sized and handsomely produced, and each contains perhaps a half–dozen pictures which could fit comfortably in the other two. Each offers a distinctive view of the state. An unabashed art photographer, Kanfer focuses on the former Grand Prairie of east central Illinois, a landscape a bit forbidding even in its verdant moods, one which is familiar without being homelike. Irving's *Illinois* (accompanied by Kristina Valaitis' economical text) offers a more comprehensively documentary vision than Kanfer's. The book spans the state from Michigan Avenue to Main Street and from corn field to log cabin. A botanist by training, Clay celebrates the nature which

Under the Rainbow
Photography: Larry Kanfer

Fishermen at Twilight,
Rend Lake, Illinois
Copyright 1988: Gary Irving

Autumn Leaves and Woodpile
at New Salem State Park
Copyright 1988: Gary Irving

survives in Illinois mainly in its more remote state parks and nature preserves – an unfamiliar, even eerie Illinois of cypress swamps and stone canyons, waterfalls and forest floors. Irving portrays the Illinois that is, Kanfer shows the state as it is often imagined to be, and Clay how it used to be.

Their techniques vary. Clay uses a jumbo 4 X 5 view camera, Irving specializes in panoramic views, and Kanfer occasionally manipulates images so as to mimic Seurat's pointillist effects. The crucial difference between them is not equipment but sensibility. For example Clay and Kanfer agree that a photograph owes as much to the photographer's imagination as it does to the scene itself, that before a scene can be captured, it must be seen.

In his introduction to *Prairiescapes*, Kanfer explains how he relies on colors, textures, lines, and moods – the essence of things rather than the things themselves – in shaping his compositions. The result is what Kanfer calls a concept.

If Kanfer aims to abstract images out of the diffuse elements of his scenes, Clay seeks to particularize them "I try to find something that's really interesting within the landscape," he says. In one scene it might be the pattern of a tree's bark, in another mushrooms pushing up through a blanket of leaves. In each case, Clay says, "Something tells me, 'That needs to be photographed.' " He shuns broad landscape shots because "there is nothing to draw one's eye into it."

Irving, interestingly, believes that his photographs take their shape as much from the viewer's imagination as from his. "If what people react to in a picture is light and shadow or the composition of shapes, it's art," he explains. "If they react to its more objective elements, it's journalism."

None of these celebrators of Illinois is a native. Irving has lived in Illinois since 1961, Kanfer since 1973, and Clay only since 1982. Each saw Illinois for the first time with an eye undulled by familiarity, and each was surprised.

"After I signed the contract to do the book," recalls Clay, a former Arizonan, "I asked my wife, 'What is there to shoot?' But I was absolutely stunned by the scenic beauty in the state." Irving's expectations were similarly low when he was asked by his publisher to turn from Vermont and Chicago (subjects of his two previous books) to Illinois. "It's so extremely flat, and there's such an overwhelming sense of space," Irving says of much of Downstate. "Ironically, that became one of my favorite places to photograph. It's almost an archetypical American landscape." Kanfer grew up in Oregon amid a landscape of obvious charm, but found that Illinois offers "a gentle, subtle beauty" to those who bother to look for it. "I think," he says, using a word not often associated with Illinois, "that this is a terribly romantic landscape."

Evening Light on Castle Rock and Rock River, Castle Rock State Park, Ogle County
Copyright: Willard Clay

Patch of Blue Flag (Iris), in a Marsh
Copyright: Willard Clay

Street vendor

(continued from p. 3)

eras, accelerated aboard the steamboats and the railroads which later connected the docks to the hinterland. One such cargo was music, which was unloaded in the speakeasies, bordellos, and gambling joints of the 1920s. St. Louis has long been associated with blues and jazz as each worked its way up the Mississippi toward Chicago. East St. Louis' vice district, "the Valley," was where one could hear seminal bluesmen such as William Bunch ("Peetie Wheatstraw"). If St. Louis was immortalized by songwriter W.C. Handy, its namesake in the Bottom found a troubador in Duke Ellington, who wrote *East St Louis Toodle–Oo.*

River towns, like river people, tend to move on. Governments have preserved a few relics of the many cultures which have made the Bottom home. The stories of their occupations have not been similarly preserved. Why did the French array their villages the way they did? Why did they build their forts where they did? Ekberg acknowledges that we can only guess. What happened to the Mississippians? Woods can speculate but that is all. Urbanization is obliterating the story of even recent American occupation. Surveyors scouting routes for a federal rail relocation project near Centreville found what they called a "Late Hippie" style wind–powered grist mill made by 1970s back–to–the–landers from concrete and chicken wire. "It is not a giant anthill nor is it an ancient Druidic ruin," the project surveyors noted of the doomed mill in their report. "There is a strong possibility that there is not another structure in the world like this one." Another ruin, another people, another layer added to the history of The American Bottom.

This is the first of a two–part feature on the American Bottom. Part two, which will appear in the Spring/Summer issue,will focus on how the peoples of the Bottom reshaped its environment.

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Understanding Our Natural Heritage

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THE NATURE OF ILLINOIS

Spring/Summer 1989

Published by the Society for the Illinois Scientific Surveys

THE NATURE OF
ILLINOIS

Spring/Summer 1989

The Society Page

Celebrate spring with us at *The Nature of Illinois.* Illinois has more than 170 beautiful **nature preserves** dedicated to protect their unusual beauty and unique plant and animal life. With help from the Illinois Natural History Survey, we offer you a chance to go daytripping at eight of our state's most scenic sites.

The American Bottom, a catalog of lowland topography, has been home to paleo-Indians, mound-building Mississippians, the French, English and now modern Americans. From chert to coal, each culture has found a wealth of natural resources on the floodplain.

After World War II, the U.S. Army encouraged many discharged officers to seek civilian careers in outdoor recreation. Leo Whalen, one such ex-officer and a Society Board member, followed their advice and turned to raising some of the most prized ducks around at his farm, **Whistling Wings**.

Chicago was "the city of wood" until the Great Fire of 1871 took its toll. Joseph Medill was elected mayor on the Fireproof ticket and the city rebuilt in stone. The Illinois Geological Survey traces the ups and downs of **Chicago's building stone industry**.

Northeastern Illinois was recently hit by two history-making floods, with damages of over $142 million. In its **Floodplain Information Repository**, the Illinois Water Survey erected a first line of defense against one of nature's most devastating forces.

The body of an Indian child was laid to rest 2,000 years ago in Pike County amid a wealth of burial pottery decorated with long-ago birds. **The Art of Nature** looks at **The Elizabeth Birds**.

I hope you will join me in becoming a member of the Society.

Have a happy and natural spring.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Prairie vole feasting on a sunflower seed. Photographer: Dr. Michael Jeffords.

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Editorial Staff
Jane A. Bolin *Editor*
Jane Christman *Assistant to the Editor*
Michael Jeffords *Photographer*

Design
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Stay In Touch

Name, address or delivery changes, membership or contribution inquiries, letters to the Editor, should be addressed to The Society for the Illinois Scientific Surveys, 319 W.Cook St., Springfield, Il., 62704, (217)522-2033.
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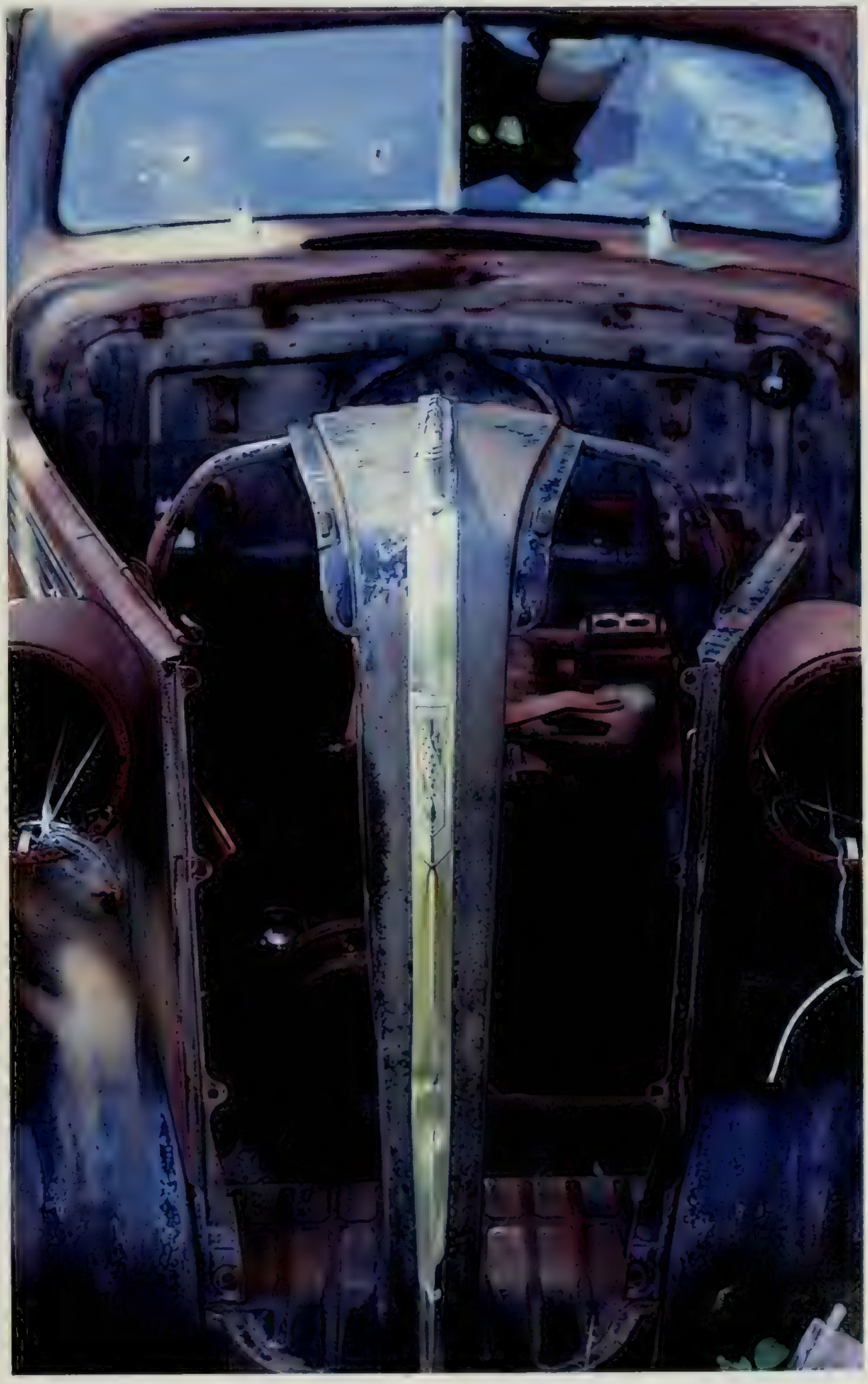
THE AMERICAN BOTTOM

by James Krohe Jr.



Abandoned car

The old American Bottom - Illinois' part of the Mississippi River floodplain which curves south of Alton for some 70 miles - was not exactly a paradise: no place which flooded so often and bred so many mosquitoes could be. But the Bottom has been hospitable enough that humans have made it home for at least 10,000 years. The river carved itself a valley out of solid bedrock; that valley averages roughly four miles in width except for an 11-mile bulge that the river scooped out of soft Pennsylvania Age rocks opposite today's St. Louis. Somewhat perilously perched on this shelf is the biggest concentration of people and industry on the Mississippi floodplain north of New Orleans.

The Bottom (or Bottoms, as it is also known) is a catalog of lowland topography: swales and ridges, sloughs and backwater lakes, alluvial fans formed by sediment washing out of the surrounding bluffs and the remnants of Ice Age terraces, all watered by the meandering river. Scientists have identified five distinct ecological zones in the Bottom, from which both Indian and European settlers took timber, game, fish, and waterfowl. Edible marsh grasses, shellfish, roots, nuts, and berries were plentiful in season, and the Bottom's silty soils provided easy planting for domesticated crops.

From Chert To Horseradish

Whatever their differences, the succession of human cultures which thrived on the Bottom, from paleo-Indians to the mound-building Mississippians to the French, English, and modern Americans, used these natural resources in surprisingly similar ways. What local deposits of chert (a kind of flint) were to Indians, coal was to 19th century factories. The Indians' specialized camps for nut harvest or fishing sound a bit like the one-company towns

Factory scene in East St. Louis

such as Wood River or Alorton that sprang up around the Bottom's oil refineries and metals plants. And their satellite towns and family-scale farm outposts are mimicked by the suburbs and scattershot housing developments which today sprawl across the Bottom.

Indian farmers preferred the same low-lying, nonacid, silt-loam soils that were coveted by later French and American farmers. Such virgin soils were fabulously fertile (Early 19th century travelers reported yields of corn of 120 bushels per acre).

The diversity of crops grown here is owed in part to the wide range of soils and in part to the immigrant farmers who planted what they were familiar with - sweet corn, horseradish, pumpkins, melons, gourds and wheat. More than nine million pounds of horseradish is produced annually by about 30 growers. More than half the U.S. crop is harvested in Madison and St. Clair counties, where it has been a mainstay of the economy since 1920. Only the vegetable truck farms around Chicago produce more.

Fertile And Fragile

Those soils are fertile but fragile. Bill Woods, a geographer and archaeologist at Southern Illinois University at Edwardsville who has been digging at Cahokia, sees that fragility as crucial to the Mississippians' decline. "The Bottom was not heavily forested at all. The Mississippians used a lot of wood for construction" - one mile-long wall of the defensive palisade around Monks Mound wed 4500 logs and it was rebuilt at least three times - "but their use of wood for fuel would have been tremendous. They would have exhausted the wetland tree species for several miles."

The resulting deforestation of the bluff valleys would have had disastrous effects, as erosion from the denuded bluffs would have aggravated flooding in low-lying areas. The periodic flooding of agricultural soils was no disaster to the Indians, who relied on floods each winter and spring to bring to their fields new nutrients eroded from upstream soils. The problem was that deforestation may have disturbed the previously predictable timing of the annual floods.

"During heavy rains in the summers," Woods says, "flooding on the Bottom would have increased dramatically. Suddenly they were getting flooding of their prime agricultural soils into July and August. Production became unpredictable." Vulnerable fields apparently were abandoned, as the Mississippians moved their settlements upslope, onto the drier alluvial fans at the base of the bluffs.

High Waters

The Indians learned what their successors were to learn again, which is that water made the Bottom and water can unmake it too. More than 20 major floods were recorded between 1844 and 1930, but coping with high water has tested human civilization in the Bottom in every age. Early Indians, for example, simply shunned the floodplain as a site for permanent camps. The French did not, with devastating results. The meandering river drowned Old Kaskaskia in the 1880s and had undercut Fort de Chartres before that.

Carl Ekberg, an historian at Illinois State University, speculates that the French may have built their forts so perilously close to the shifting river for strategic military reasons. Or they may have done so as a result of a political accommodation with local Indian tribes under which the French agreed not to extend their settlements from the floodplain into the adjacent, Indian-occupied bluffs. Or, Ekberg adds, because the French simply hadn't lived in the Bottom long enough to learn about the Mississippi's treacherous habits.

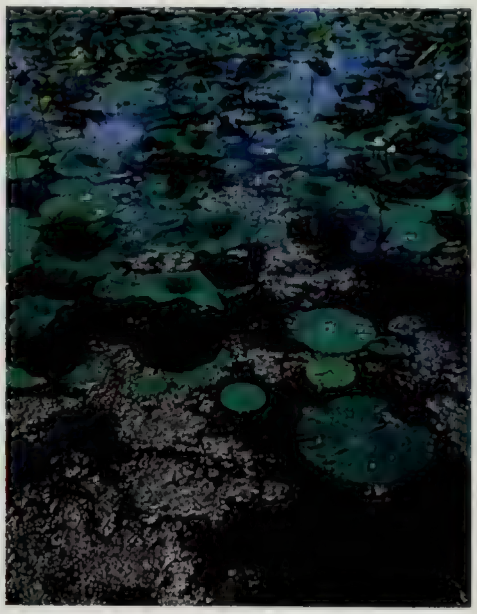
As Woods points out, the Bottom habitat environment had already been altered by humans (if inadvertently) long before the Europeans arrived there. But the technological skills of the newcomers made it possible for them to change the Bottom deliberately and permanently. Apart from the ceremonial earthen Indian mounds, the first major public works on the Bottom were the levees, drainage channels, relief wells, and catchment basins built beginning at the turn of this century. Richard Schicht, Assistant Chief of the Illinois Water Survey, notes that parts of the interstate highways which crisscross the Bottom were built in areas so wet that as much as 10 million gallons of water a day have to be pumped away to keep road foundations from crumbling.

Building On Low Ground

Stricter local floodplain regulation (based in part on flood hazard maps prepared by the Water Survey) reflects increased sensitivity to the risks of building on vulnerable floodplains.

Ironically it was the availability of water in quantity that spurred the rapid industrialization of the Bottom since 1890. Between the 1940s and 1960s especially, factories such as the Granite City steel works took in as much water per day from underground sand and gravel formations as would be used by cities of 100,000. Such heavy withdrawals, coupled with runoff diversions on the surface, caused local water tables to drop temporarily, turning wet land dry. Recent slowdowns in groundwater withdrawals have caused water tables to rise back toward pre-industrial levels, flooding basements and undermining sewer lines. The U.S. Army Corps of Engineers has planned an extensive system of dewatering wells, using a computer model developed by the Water Survey.

Gourd harvest



American lotus

But engineering can undo nature only so far. The existing levee system is designed to protect the Metro-East region from flood crests of 52 feet, the hypothetical "once-every-200-year" flood. The leveeing of channels upriver means that water which once lingered in backwater lakes now crashes downstream. The record flood of 1973 saw the Mississippi at St. Louis pushed to near 200-year heights by a volume of water which used to produce only a 30 or 40-year flood.

"Yes, we're getting higher flood stages with the same amount of water,"

(continued on p. 23)

THE BEST LITTLE DUCK RANCH IN HANOVER

by Tara McClellan

The first sign of Whistling Wings is its farm area, located on Route 84 as it winds its way to Illinois' far northwestern corner. After passing through a succession of small river towns, you almost drive by this inconspicuous complex of several grayish buildings and wire duck pens. But look carefully. What you're actually viewing are Whistling Wings' breeding pens, the birthplace of some of the most regal, scientific and hunted ducks around.

LION'S
LIONS INTERNATIONAL
HANOVER
Welcome to the World's
MALLARD DUCK CAPITAL
AMERICAN LEGION

Hanover city limit sign

The Mallard Capital Of The World

Welcome to Hanover, Illinois, the Mallard Capital of the World, as the town's Chamber of Commerce has dubbed it. Hanover owes its title to Leo Whalen, who founded Whistling Wings, the world's largest commercial producer of mallard ducks. Each year two hundred thousand ducks get their start here in tiny Hanover (population 1,100) and are shipped worldwide to hunting preserves, scientific laboratories, schools, restaurants, and more unusual places like presidential ponds (more on that later).

Whistling Wings' existence owes some thanks to the U.S. Army which, after World War II, encouraged discharged officers like Whalen to seek civilian careers in outdoor recreation (thought to be the wave of the future). That sounded good to Whalen who wanted to work outdoors after having toiled inside in tavern and pool hall businesses. While stationed in Germany during the war, Whalen had become familiar with European hunting clubs and decided to start one in his hometown of Hanover.

For those who might wonder "Which came first, the duck or the egg?" the answer in this case is the duck, two hundred of them in fact. Whalen decided to use mallards because the breed is well regulated under federal law and is the only type of duck allowed on hunting preserves. In 1954 he bought two hundred mallards and a few acres of farm land to start his hunting club. He added a small lake to the area and waited for eager hunters.

Unfortunately Hanover was too far from the city to attract hunters, and hunting preserves hadn't caught on in America as they had in Europe. Whalen branched out into raising birds, at first only for his club. Later he started selling ducks to other preserves and customers, and the production part of the business eventually became more successful than the preserve. In 1963 Whalen closed the club and concentrated on dealing ducks.

Whalen is now 72 and helps oversee the business from his hilltop house overlooking Whistling Wings' office and the adjacent river which is home to nearly 100 Whalen mallards. (A mallard is painted on Hanover's water tower.)

The combination office-hatchery is a small brick building in the middle of Hanover that looks more like an old warehouse than the base of a world class duck producer. The first thing a visitor notices upon entering the office is a dozen or so fluffy little ducklings huddled together in a glass case. This office is the hub of Whistling Wings, where orders are taken, hatching dates determined, shipping schedules arranged, and the farm's overall operations coordinated. Bill Whalen and Marianne Whalen Murphy, Leo Whalen's son and daughter, help oversee Whistling Wings from these headquarters and keep a close eye on the eggs and newborn ducklings in the adjacent hatchery.

Leo Whalen, founder

Eggs In, Ducklings Out

The hatchery is what Whistling Wings ducks call "Mom." It's here that they go from duck egg to duckling. On long tables inside the cold, concrete room lie baskets of the greenish eggs (so colored to camouflage them in grass) waiting to be placed in the six-foot tall metal incubators that look more like large freezers than surrogate duck mothers. (Each incubator "mothers" up to 15,000 eggs simultaneously.)

Before they reach this point the eggs are first gathered, up to four times daily, from the breeding pens at the farm area. Each pen houses one of four different breeding groups. The breeding groups all have one drake for every four hens, but differ on the ages of the males and females coupled together. Each group's output and quality of offspring are monitored to determine which combination of ducks produces the best quality mallards.

After the eggs are gathered from the pens, they're washed, disinfected, and stored in coolers which keep them dormant for up to seven days while more eggs are gathered. On the eighth day the eggs are "candled" to test for fertility. When held against a light a fertile egg will show a dark mass inside (the embryo), while infertile eggs will appear clear.

Each Wednesday all of the eggs are placed inside the incubators to provide them with plenty of heat and humidity. These surrogate mothers also turn the eggs once every hour to prevent the embryos from attaching to the shells.

Bill Whalen says that amassing a quantity of eggs over a week and transferring them to the incubator at one time controls the number of ducks which will hatch on a certain date. This helps coordinate the overall hatching, shipping, and delivery schedules. During the peak season of May and June, there are two hatchings each week, while there is only one hatching per week the rest of the year.

After the eggs have been incubated for twenty-four days, they're transferred to deep drawers in the tall hatcher machines which provide the eggs with more humidity than the incubators. This prevents the ducklings from having problems breaking out of their shells on the twenty-seventh day.

"We put in eggs and take out ducklings," Bill says.

Bringing Up Baby

The first order of business for the mallard neophytes is to comply with Uncle Sam. The federal government requires that each duck must have the toe on the back of one of its legs clipped off to show that it was farm-raised. After becoming "legal" the ducks are either packed in shipping containers and sent to customers wanting day-old ducks or moved a few miles down the road to buildings back at Whistling Wings' farm area.

A chorus of high-pitched, excited chirping greets vistors upon entering the confinement buildings. Thousands of ducklings ricochet off one another or huddle together in one of several pens. Each rectangular pen corrals about 1,000 ducklings of a particular age: day-old, week-old, two-weeks-old, or three and four-weeks-old. Here the ducklings get plenty of protein-rich food, heat (from sources under the ground), and water

Young mallards in pen

from rows of hanging "nipples." When the ducks are five weeks old they're moved to the real world, Whistling Wings' wetlands area.

The wetlands area is several miles from town on 400 acres of grassy, rolling land. Whalen's original hunting clubhouse is still here, looking out over one of three lakes he made for the ducks. The lakes are surrounded by 60,000 pine trees which Whalen planted and by small plots of land which he preserved for wildlife (we saw some wild turkeys on our visit). There are no fences or nets to keep the mallards in, but why leave when you have all the food and pleasant surroundings you could ask for?

Raising ducklings in natural surroundings like these ensure that Whalen's mallards are as close to wild as possible. They must adapt to a varying climate and survive such predators as raccoons, minks, cats and coydogs, a coyote-dog mix. Because they've already faced these natural elements, Bill says Whistling Wings' ducks offer clients a high survival rate.

For Emperors And Presidents

When it's time to ship the ducks (which are sold at any age and in any quantity), a rationing system is initiated and the mallards are later lured into catching pens with food. They are then placed in shipping coops and delivered via truck or plane.

There have been unplanned detours. A plane carrying Florida-bound mallards was hijacked and the ducks ended up in Cuba...permanently. On another occasion a would-be ducksnatcher tried to make off with a truck of mallards as Bill Whalen rested at a hotel on his way to a New York delivery.

Most of the mallards are delivered uneventfully to hunting preserves while the remainder are shipped to conservation groups for duck repopulation, to scientists for research, to restaurants, to schools for classroom incubation of eggs, and to golf courses for grounds beautification.

There are the more unusual customers like the Jack Daniels distillery in Tennessee which wanted ducks for its ponds (you can see the ducks in some of their print ads). Brookfield Zoo had to buy a duck a week to keep its 11-foot anaconda snake happy. Japan's Emperor Hirohito sent representatives to tour Whistling Wings before buying 200 Whalen mallards to populate the palace ponds. Malaysia wanted some ducks for a park, Beirut ordered some for a hunting preserve, England wanted some for research, and Peru's president wanted eggs for purposes unknown. Whistling Wings' mallards have also travelled to Canada, Mexico, the Netherlands and the Dominican Republic.

"You never know who you'll be talking to when you pick up the phone," Marianne Whalen Murphy says.

The transaction of which Leo Whalen is probably proudest is his trade with Lyndon Johnson. During LBJ's presidency, Whalen watched a news report which said that the ponds on Johnson's ranch were duckless. Whalen promptly wrote Johnson suggesting an exchange: ducks for an official Lone Star LBJ Ranch hat. The deal was welcomed and a presidential limousine picked up "LBJ's ducks." This wasn't Whalen's last presidential deal. In 1985 former president Richard Nixon bought some ducks for his California ranch.

A Festival Of Fowl

Ducks range from $.95 to $16.75 each, depending on their age and the quantity ordered. For five dollars you can adopt a duck. Each year Hanover holds a Mallardfest, its version of October Fest. It is held the first weekend in October and is dedicated to everything about ducks, according to Bill Whalen. Part of that weekend is Whistling Wings' Adopt A Mallard Program. Participants name their ducks, receive their official certificates of registration (like a mallard birth certificate), have the ducks banded, and get their pictures taken as they release the birds into the wild blue yonder from Hanover's bridge. Each year the program becomes more popular and the ducks' names get crazier.

(continued on p. 24)

Mallard duck eggs

DAYTRIPPING

Black oak on Illinois Beach dune

Daytripping is an old and honored custom among England's middle classes. Brighton Beach, Dover, Blackpool and the Isle of Wight are all common destinations of Britons looking for a relaxing holiday, which will probably include bathing, punting, a pub visit and picnicking. While the English picnic basket is more likely to include Scotch eggs, sausages, cucumber sandwiches and a Cornish pasty or two, Americans will probably feast on fried chicken and potato salad. The English will travel on a special good-for-one-day ticket on British Railways. Americans will, of course, drive.

The mode of transportation or the menu isn't important; getting back to nature is.

Illinois has more than 170 areas where you can get back to nature, all dedicated as nature preserves to protect their unusual beauty or unique plant and animal life. Many contain endangered species or geological formations which can't be found anywhere else in Illinois. The public can visit most of these areas, although few have accomodations.

With expert advice from the Illinois Natural History Survey, we have chosen to profile eight scenic Illinois sites that are nationally recognized nature preserves. For more information about all of Illinois' preserves, call the Illinois Nature Preserves Commission at 217/785-8686.

Illinois Beach

In this frequently visited 829-acre preserve near Zion you'll see a prairie, savanna, marsh, dunes, beach, sedge meadows, pond, swales and the "Dead River." Unusual plant life includes wild orchids, sandbinding grasses, prickly-pear cactus and black oaks. Interesting fish, insects and more than 150 species of migratory birds abound. A nature center, trail system and trail guide can assist visitors. To get there from Zion, take Sheridan Road south about one mile to Wadsworth Road. Go east to Illinois Beach State Park and south of the park's lodge.

Little Black Slough

The Heron Pond-Little Black Slough Nature Preserve in southernmost Illinois is 1,861 acres of swamps (considered some of the finest in Illinois), bottomland and upland forests, streams, limestone glades and rocky bluffs. Most of the year the grounds are covered by up to six feet of water, supporting such interesting flora and fauna as huge bald cypress trees (among Illinois' oldest), tupelo trees, the bird-voiced tree frog and the cottonmouth. To get there from Vienna, take Highway 45 south four miles to the preserve on the east side of the highway.

Revis Hill Prairie

Revis Prairie is one of Illinois' largest hill prairies. This 53-acre preserve contains upland forest and several types of prairie grasses. The purple coneflower, prairie clover and other plants thrive there. The western hognose snake, western slender grass lizard, ottoe skipper and numerous insects also make this home. Take Highway 97 to 0.5 miles north of Kilbourne. Turn east and take the blacktop road 7.5 miles to a gravel road. Turn and travel southeast one mile. The preserve is northeast of the road.

Beall Woods

Next to the Wabash River lie 329 acres of old forests, sandstone cliffs, and streams in Beall Woods, which has the largest Shumard oaks in the world and other oak and hickory giants. (Some tower 130 to 160 feet high.) Rare fish like the mountain madtom live in the river next to the Woods, and more than 100 species of birds have been observed there. Interesting plants like jack-in-the-pulpits grow here. From Keensburg, take the blacktop road east 1.5 miles to the Beall Woods Conservation Area.

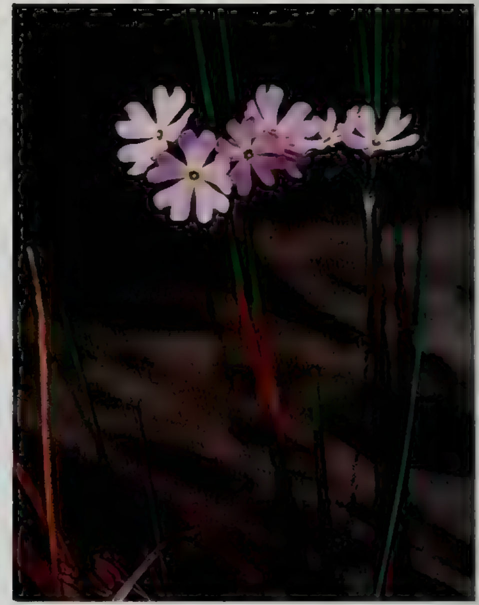
Sand Praire-Scrub Oak

Located between Bath and Kilbourne, this 1,460 acre preserve features sand savannnas, sand prairies and dunes. The sand prairies and old fields contain savanna of blackjack oak and several types of prairie grasses. From Bath take the blacktop road east 3.6 miles, then turn south for 1.3 miles. The nature preserve is west of the road.

Lusk Creek Canyon

Grottos, gorges and glades help form this 125-acre preserve, part of which is in southern Illinois' Shawnee National Forest. Lusk Creek cut into the sandstone bedrock, shaping cliffs from a few feet to nearly 100 feet high. Luscious oak, beech and tulip trees flourish in the valleys while moss and ferns cling to the cliffs. Take Golconda Road north of Eddyville at the junction of Highway 145 and Golconda. Travel southeast on Golconda 0.2 miles to a gravel road. Go east and north 1.5 miles to the parking lot. Walk two miles on the foot trail to the preserve.

Lusk Creek Canyon



Bird's Eye primrose from Apple River Canyon

Apple River Canyon State Park

This 297-acre park in northwestern Illinois offers limestone bluffs, ravines, springs and streams. Some prairie remnants and forest remain, hosting several types of prairie grasses and oak, elm and pine trees. Cliff swallows live on the bluffs and primrose adorns the cliffs. Picnic, camping and fishing facilities are available. The park can be reached from Interstate 20 or Highway 78. Call 815/745-3302 for specific directions.

Spring Bay Fen

To visit this 27-acre marshland preserve 15 miles north of Peoria, you must first get permission from the Illinois Department of Conservation's Natural Heritage Biologist at 309/347-5119. The site is near the Illinois River's backwaters and offers floodplain forests and tall shrub fen. While it has been inundated by floodwaters in the past, its features, like wild orchids, highbush cranberrry, poison sumac and pussy willow are still intact. The Natural Heritage Biologist can provide specific directions to the fen.

SURVEYING ILLINOIS

BIORHYTHMS

The Ones That Didn't Get Away

Illinois Natural History Survey (NHS) scientists are busy conducting a creel (the basket in which an angler stores his catch) survey of sport fishing on the Illinois portion of Lake Michigan. In 1987 the total fishing effort in the area exceeded two million angler hours, with over half attributable to summer pedestrian anglers. Harvest estimates for seven sport fishes exceeded $3.8 million, and over $10 million was spent on fishing trips to Lake Michigan.

The study, over three years old and scheduled to continue through 1989, is under the direction of NHS scientist Dr. W. Horns and associates, with support from the Illinois Department of Conservation and the U.S. Fish and Wildlife Service.

Crayfish Aquaculture

The market for crayfish, an increasingly important aquaculture product, is expanding rapidly into Illinois restaurants and supermarkets. Several species of crayfish grow to marketable size in one year in Illinois, suggesting a big market for crayfish grown in the Prairie state.

Natural crayfish foods include vegetative debris and invertebrates found in aquatic sediments. Natural History Survey and University of Illinois scientists have also studied the value of inoculating wheat straw with certain bacteria isolated from natural habitats. When the wheat straw was inoculated and allowed to incubate for six days, levels of essential nutrients rose measurably, providing a potentially inexpensive cheap source of crayfish feed.

Mid-Air Collisions

A single white pelican weighing about 15 to 20 pounds was responsible for the loss of a $230 million Air Force B1B bomber and three flight personnel in La Junta, California in 1987. The plane was flying below 500 feet when the pelican flew into one of the plane's support structures and severed a hydraulic line. Virtually the only defense now against such accidents is pilot awareness. That is the focus of a research project by NHS researcher Dr. Ron Larkin.

Flocks of snow geese, Canada geese, starlings and other potentially hazardous birds are observed on radar to provide pilots with early alerts. Concentrations of 50,000 to 100,000 starlings roosting on the grounds of Willard Airport, Champaign, were observed in December of 1987, and aviation officials were advised on how to cope with the problem. Ground sitings of large flocks like these are complemented by radar detection and recognition of their distinctive spatial patterns and morning nest departure times. A far more difficult problem is presented by fall goose migrations - approximately 10,000 snow geese and over 250,000 Canada geese in Illinois. Radar detection is inevitable, but their identification is much more difficult and must be determined relatively quickly to avoid aircraft-large bird collisions.

Asian Tiger Mosquito Survey

Forty-two Illinois counties were surveyed in 1987 for the presence of the potentially lethal Asian Tiger Mosquito (*Aedes Albopictus*) in its primary larval habitat - used tire dumps. Major tire dumps were found in 32 of the 42 counties observed, primarily in southern Illinois. The rapid spread of the mosquito was inhibited by last summer's drought conditions, with the mosquito confined to three counties: Madison, St. Clair and Cook.

Within those three counties, however, more sites were infested with *albopictus* than had been found in previous years. Legislation is being drafted for the spring session to address the issue of scrap and waste tires in Illinois, major breeding grounds for the Asian Tiger Mosquito.

Recycling Pesticide-Contaminated Soil

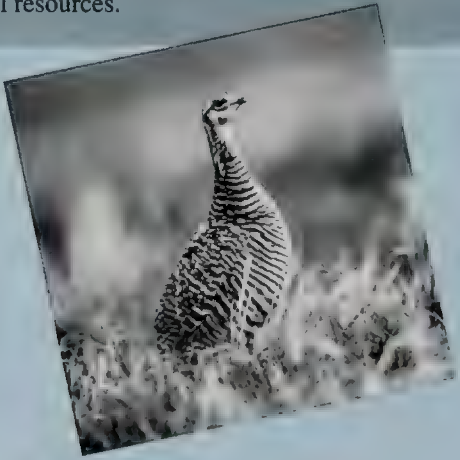
An estimated 1,200 agrichemical retail facilities are scattered throughout Illinois. Hazardous concentrations of pesticides may accumulate at these sites through accidental spills during mixing, loading and cleanup operations. Natural History Survey researchers are investigating the feasibility of removing contaminated soil and applying it to agricultural fields.

Herbicide residues in soil, groundwater and grains resulting from this land application of wastes were monitored and compared to herbicide residues from freshly sprayed products. The researchers found that herbicides degraded more slowly when applied to fields as waste soil than when freshly applied. These waste herbicides were still active, although less than freshly sprayed material, against several weed species. In addition no residues were detected in crops, and the pattern of herbicide presence in groundwater was not related to application treatments.

Dr. Glen Sanderson Promoted To Principal Scientist

Dr. Glen Sanderson, the world's authority on the raccoon and a highly respected authority on waterfowl, has been promoted to the rank of principal scientist at the Natural History Survey. Dr. Sanderson has a long and distinguished record of scientific and professional achievements, including the Oak Leaf Award of The Nature Conservancy, the Conservationist of the Year Award from American Motors Corporation, and the Professional Merit Award of the North Central Section of the Wildlife Society.

His efforts played a key role in the replacement of lead by steel shot for waterfowl hunting and in preserving the remnant populations of prairie chickens in Illinois. As section head of Wildlife Research for nearly 25 years, he has unselfishly provided leadership, advice and guidance to all those who care about our natural resources.



Prairie Chicken
(Courtesy: Illinois Natural History Survey)

CURRENTS

Lead In Drinking Water

To help utilities meet new, stricter U.S. EPA regulations on lead in drinking water, the Illinois Water Survey (IWS) is conducting research for preparation of a guidance manual for utilities nationwide.

The manual, funded by the American Water Works Association Research Foundation, will provide guidance to utilities in identifying lead sources, selecting water treatment alternatives and monitoring their effectiveness.

The manual is expected to be available in July. For more information, contact Chet Neff at the Water Survey, 217/333-4954.

Illinois Water and Air Under Stress

At sites throughout the state that comprise the Illinois Benchmark Network, the Water Survey regularly collects data on shallow groundwater levels, climate characteristics and suspended stream sediments.

The long-term data collected will help answer questions and resolve conflicts on such issues as the use of groundwater for irrigation, methods for decreasing stream and lake sedimentation and the feasibility of solar and wind energy systems.

"The water and atmospheric resources of Illinois are under more stress now than at any other time in history," according to network coordinator Dick Schicht. "Demand for water is increasing. And more and more wastes - including hazardous wastes - are being disposed of. The data collected at network sites should help us solve Illinois' environmental problems."

Metro East Groundwater Studied

Intense industrial activity has exposed shallow groundwater supplies in the Metro East area of southwestern Illinois to industrial pollutants. To study the area's groundwater quality, Water Survey researchers have installed groundwater monitoring wells in southern Madison and northern St. Clair counties.

The project is part of a study to assess groundwater quality in areas of the state identified as highly susceptible to groundwater contamination. The Survey has completed a study of groundwater quality in the Rockford area and will begin a study in the Peoria-Pekin area this spring.

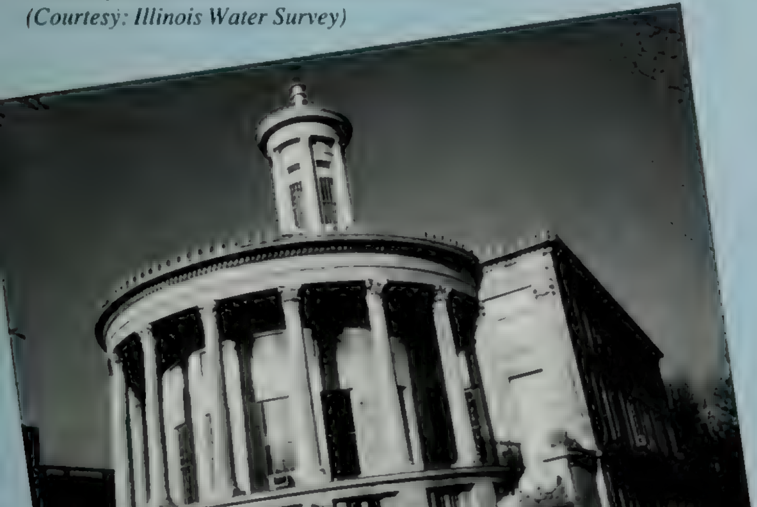
Contamination by both industrial sources and agricultural chemicals will be monitored during the project. The monitoring wells were installed at Cahokia, Centreville, Collinsville, East St. Louis, Glen Carbon, Granite City, Madison and Horseshoe Lake State Park.

Weathering Time and Pollution

While the National Park Service contemplates an extensive conservation effort to preserve Philadelphia's Merchants' Exchange Building, Water Survey researcher Don Dolske is studying the effects of climate and pollution on the eroding building.

The 155-year-old structure, which is part of the Independence National Historical Park, shows signs of surface erosion, discoloration and loss of stone integrity. The project offers a unique opportunity to study the weathered marble of an architecturally and historically significant building and enhance understanding of how materials withstand such factors as local pollution and acid rain.

Philadelphia Merchant's Exchange Building (Courtesy: Illinois Water Survey)



Saving a landmark (Courtesy: Illinois Water Survey)

CENTERING ON WASTE

Reducing Waste

Reducing the volume and toxicity of wastes generated in Illinois' manufacturing process is the goal of a new U.S.EPA-funded program to be administered by the Hazardous Waste Research and Information Center (HWRIC).

Illinois was chosen as one of six states to receive $300,000 over three years for the WRITE (Waste Reduction Innovative Technology Evaluation) program. HWRIC will introduce new waste reduction techniques to Illinois industries, disseminate information about these techniques and establish reliable performance and cost information for waste reduction techniques.

WRITE

Hazardous Wastes In The Classroom

Chemistry and other science departments in small colleges and high schools generate enough hazardous wastes (220 to 2,200 pounds per month) to qualify as small quantity generators under federal regulations. Frequently they lack the technical expertise and financial resources to address problems associated with these wastes.

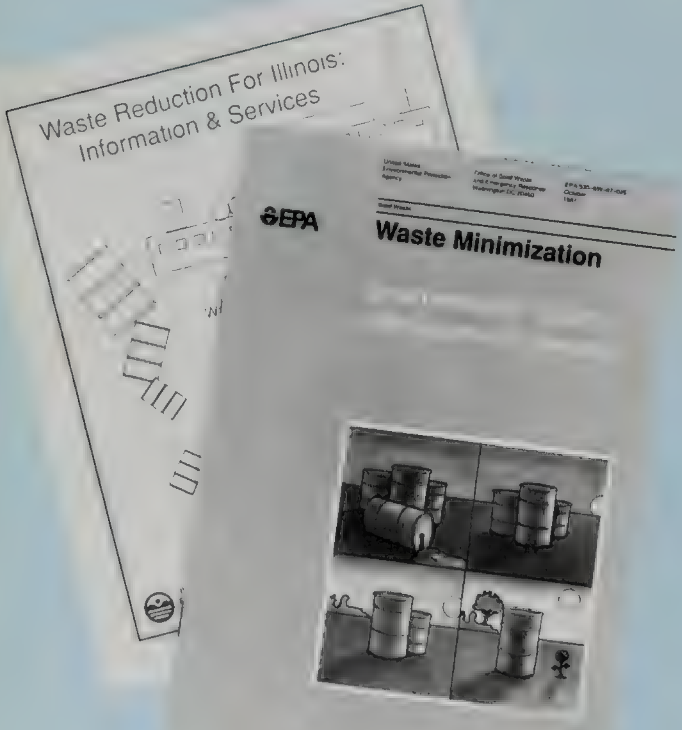
With funding from HWRIC, Dr. Wayne Wesolowski of Illinois Bendictine College in Lisle will head a project aimed at developing low-cost, innovative solutions to the problem. Dr. Wesolowski will form a waste disposal consortium with other local colleges to establish teaching methods for training students in reducing hazardous wastes. Information on hazardous waste regulations applicable to college and high school laboratories will also be assembled.

Results of the project will be shared with local groups through state-sponsored workshops. More than 400 high school teachers alone are expected to participate. The first workshops are scheduled for spring.

Publications Help Industries Reduce Hazardous Waste

Four publications are now available from HWRIC to assist Illinois businesses and other hazardous waste generators: *Waste Reduction for Illinois: Information & Services, The EPA Manual for Waste Minimization, Waste Minimization: Environmental Quality with Economic Benefits, and The Illinois Small Quantity Generators' Manual (2nd edition).*

These publications are available free from HWRIC: 1808 Woodfield Drive, Savoy IL 61874; 217/333-8940.



GEOGRAMS

World's Most Powerful X-Ray Source Sited

The Illinois Geological Survey (IGS) recently helped to determine critical geological and hydrogeological parameters for preliminary design and construction of the world's most powerful X-ray source - the Advanced Photon Source (APS), funded by the U.S. Department of Energy and planned for construction at Argonne National Laboratory in Illinois.

The Survey's investigations, funded by $250,000 from the Illinois Department of Energy and Natural Resources, increase confidence that the foundation for the positron storage ring will be stable. This is a necessity for effective operation of the equipment, designed to produce high-energy X-ray beams 10,000 times brighter than currently possible.

The facility will be used by researchers from academia, industry and governmental laboratories in materials science, biology, medicine, biotechnology, chemistry, physics and geosciences. At any one time 300 scientists will be able to use the APS.

Underground Power

Illinois has abundant energy resources, mostly in the form of 181 billion tons of underground coal, about one-tenth of total coal resources in the United States. The coal's high sulfur content represents one barrier to development. Others - like depth of coal or proximity to areas already drilled for oil - have been extensively studied by Geological Survey researchers.

Little is known, however, about the impact of other factors such as land use limitations, development of other mineral resources and other restrictions. The Illinois Geological Survey will work with the U.S. Geological Survey (USGS) to update coal resource and reserve figures in a study that will look at 10 to 15 representative areas selected to reflect the range of coal resources and restrictions on mining. That data will be extrapolated to estimate available coal in the state and Illinois Basin.

New Map Series Available

A new version of the Illinois Coal Mine Map Series detailing the extent and location of coal mining operations for 73 counties as of January, 1987 has been completed by the Survey. This 80-map series features surface and underground mines (both active and abandoned) and other technical data at a new scale of 1:100,000 for easy use with the USGS' 1:100,000 scale, 30 by 60 feet, quadrangle map series and Illinois county map series available from the IGS. Each map is accompanied by a county directory of coal mines listing company names, mine names, type of mine, years operated, coal seam mined and mine location.

Available on either paper ($2) or polyester film ($5), these maps can be obtained from the Coal Section, IGS, 615 East Peabody Drive, Champaign, IL 61820. The Survey can also design customized maps for any of the 73 mined counties.

Looking Through The Layers

Distribution of earth materials from the surface to a depth of 15 meters (49.3 feet) and horizontally over a specified area is depicted in a stack-unit map now available for the entire state of Illinois. Comprised of four separate regional maps, the stack-unit map provides basic geologic information for regional land-use planning.

The maps and an explanatory publication by Dr. Richard Berg and Dr. John Kempton of the Survey are sold as a package for $9.75 plus postage and handling fees by the Order Department, Illinois Geological Survey, 615 East Peabody Drive, Champaign, IL 61820 or call 217/333-4747.

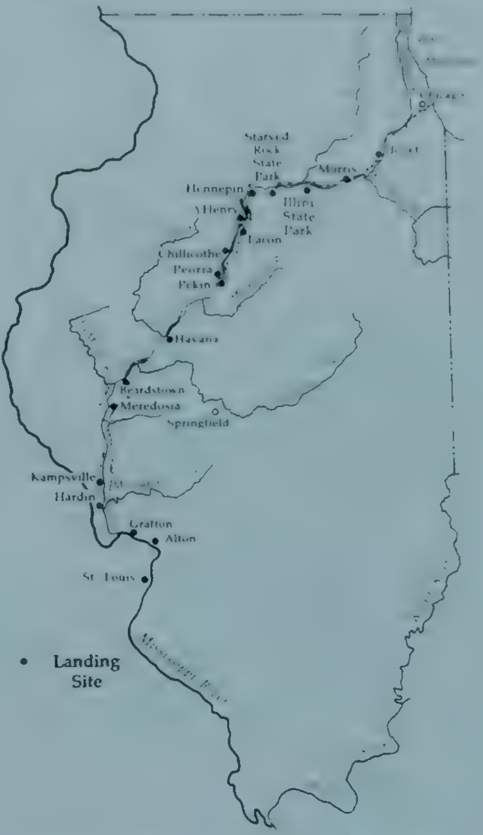
The Geological Year In Review

To provide the public with a look at current projects and critical natural resource issues facing the state, the Geological Survey has published highlights from this fiscal year. A copy of this free document may be obtained by written request to: Order Department, Illinois Geological Survey, 615 East Peabody Drive, Champaign, IL 61820.

MUSEUM MOMENTS

Harvesting the River: Life and Work on the Illinois River will be a waterborne exhibit highlighting the history of the Illinois River Valley. The *Belle Reynolds*, a renovated tow boat, will transport the exhibit the length of the Illinois Waterway during the autumn of 1989. Navigating from Joliet to St. Louis, the boat will tie up for several days at each of 18 scheduled ports of call (see map at right). Visitors will be invited on board, free of charge, to view the multimedia exhibit. Each community is planning special events around the river theme.

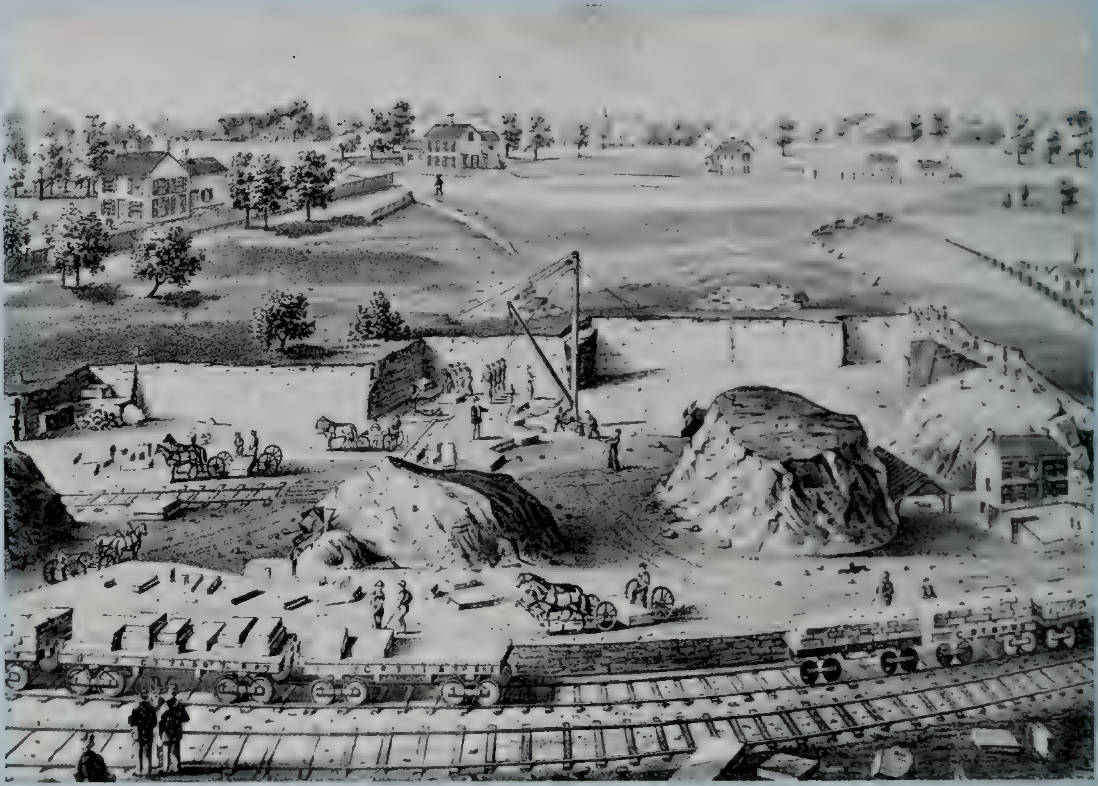
For more information about the exhibit and specific dates, contact Lori Grove or Craig Colten at the Illinois State Museum, 217/785-4842.


Chicago
Joliet
Starved Rock State Park
Morris
Hennepin
Henry
Illini State Park
Lacon
Chillicothe
Peoria
Pekin
Havana
Beardstown
Meredosia
Springfield
Kampsville
Hardin
Grafton
Alton
St. Louis
Mississippi River
● Landing Site

BUILDING CHICAGO WOOD, FIRE, WATER AND STONE

The stone called dolomite or limestone was rarely used by pioneers settling along the shore of Lake Michigan in northeastern Illinois in the early 1800s. Although stone was easily visible to these early settlers, timber cut from nearby heavy forests was easier to use for homes, barns, fences, small churches and one-room schools. Historical records are incomplete but it's safe to assume that by 1830, Fort Dearborn was using some stone for building.

In that year, the first quarry in what was to become Chicago opened. Many of the city's historic buildings were made of stone quarried during the industry's early years. But Chicago was essentially a "city made of wood" until the Great Fire of 1871. The fire-proof value of stone as a building material was obvious, and dolomite was used to rebuild Chicago.



From "Combination Atlas Map of Will County, Illinois" Thompson Bros. & Burr, Elgin, Illinois (Courtesy: Illinois Geological Survey)

Continent Building

The dolomite found in northeastern Illinois was formed during the Silurian Period, which began 438 million years ago and lasted for 30 million years. The long process began when virtually all of North America was covered by seawater. The original limestone was deposited in the shallow sea by accumulation of the shells of mollusks and other calcite-secreting organisms. Dolomite was formed by a chemical process that converted the original limestone to the mineral dolomite. The Silurian Period was followed by several other episodes of marine incursions onto the continent, deposition of sediments, uplift of the sea bottom, and retreat of the ocean and erosion. The last sea left the Chicago area about 300 million years ago.

After the seas retreated, rocks that had been deposited over the dolomite were gradually removed by erosion and streams. Beginning about two million years ago, according to Dr. John Kempton of the Illinois Geological Survey, glaciers repeatedly pushed southward over the Chicago area and melted, leaving behind layers of clay, sand and rock debris picked up during their advance. The glaciers and their meltwater modified the surface, eroding the glacial debris and often the dolomite bedrock. About 12,000 years ago the last of the glaciers melted. The final surge of meltwater spilled out of Lake Michigan to produce additional erosion and expose the buried Silurian dolomite in many areas.

Ribbons Of Water And Steel

The growth of the building stone industry was intricately related to the construction of harbor facilities, the Illinois and Michigan Canal and the development of a reliable system of railroads. In 1827 federal surveyors studied the long-standing problem of an immense sandbar at the mouth of the Chicago River. For years, city officials - and before them soldiers from Fort Dearborn - had tried to keep the river's mouth open for shipping. All manner of manmade controls failed to prevent the annual buildup of sand and silt where the river emptied into Lake Michigan. Annual clean-ups were routine until almost the last quarter of the 19th century.

At first Chicago's stone was king. The Bridgeport quarry - Chicago's first - opened in 1830. Thousands of Irish immigrants poured in from the east looking for jobs (see companion article). Hauling stone from the quarry to the lakefront, building piers and breakwaters, loading and unloading goods from barges were heavy tasks performed by mostly Irish immigrants.

That was the case until the Illinois and Michigan Canal was built. As early as 1673, the explorers Jolliet and Marquette realized the value of a canal connecting the Chicago and the Des Plaines Rivers. A few miles of portage across swampy land was all that prevented the explorers' canoes from traveling all the way from Lake Michigan to the Mississippi and then south to New Orleans. In 1827 the federal government surveyed the area around Lemont, Lockport and Joliet as a potential terminal for such a canal. The Silurian dolomite layers found in that area ultimately proved superior to those found in the immediate vicinity of 19th century Chicago as sources of building stone.

The 96-mile long Illinois and Michigan Canal, completed in 1848, connected the Mississippi and Illinois Rivers to Lake Michigan through the south branch of the Chicago River. "The Illinois and Michigan Canal was to Chicago what the Erie Canal was to New York. It opened the way for Chicago to engage in international trade," explains Lee Hanson, Executive Director of the Illinois and Michigan Canal National Heritage Corridor. Two years after the Canal opened, a network of railroads was in place. Chicago was now the heartland link, east and west, by water and by rail.

Chicago grew. When the Canal opened in 1848, Chicago's population stood at 20,000. Forty-one years later in 1889, the population was a whopping 1,099,850. Chicago was hailed as the busiest harbor in the world. Completion of the canal provided low-cost water transportation for the building quarries being developed near Joliet and Lemont and greater access to the rapidly expanding Chicago market.

Bridgeport quarry, Chicago, Illinois (Courtesy: Illinois Geological Survey)

From The Heights To The Pits

Many of Chicago's remaining historic churches, schools and homes are heavy, handsome structures built of dolomite during the latter half of the nineteenth century. The old pumping station and the Water Tower in Chicago and the State Capitol in Springfield are examples of the majesty of the area's once-great stone industry. With ups and downs along the way, the Chicago building stone industry grew for nearly a century until World War One when several events conspired to cause its collapse.

The demise of Chicago's building stone industry is attributed to many causes, but primarily to changing architectural styles and building technology. In addition quarries were hemmed in by urban growth. To find more stone, operators had to dig deeper and at greater cost. A shrinking market coupled with the necessity for deeper mining caused many quarries to close, leaving abandoned pits in their wake. The pits became dumps and landfills. The old Bridgeport quarry was Chicago's first to open and the most recently closed.

As the use of building stone in Chicago declined, the demand for crushed stone for use as aggregate increased. In 1987 Illinois ranked sixth among the states in the production of crushed stone. Almost half of that stone came from quarries in northeastern Illinois, primarily from three quarries in Cook County. Unfortunately, like the early building stone quarries, the continued availability of crushed stone is itself threatened by urbanization.

Assuring The Future

Dr. Donald Mikulic of the Illinois Geological Survey states that "We need to find new, local sources of high-quality stone products to supply the vast markets in northeastern Illinois." Some success has been achieved at the Elmhurst Underground Quarry. The mine is 520 feet below ground surface and is entered by an inclined tunnel that begins 222 feet below ground and runs across and down to reach a new source of dolomite. Innovative techniques are being devised to sustain the growth of Chicago's crushed stone industry.

Today's aggregate materials are just as necessary to a thriving economy as the building stone of earlier days. To honor that proud past, a huge block of Silurian dolomite is Illinois' contribution to the construction of the Fountain of Freedom commemorating the 200th anniversary of the United States Constitution.

Vulcan Materials Company quarry, Cook County (Courtesy: Illinois Geological Survey)

Shanties, Rum And Company Stores

In 1830 with a population of 150, the fur-trading and military post called Fort Dearborn was large enough to be officially designated a village. The frontier settlement was strategically located at the mouth of the Chicago River.

Funded by local monies, work on the Illinois and Michigan Canal began in 1836, six years after Chicago's Bridgeport Quarry opened. Word of the project spread. Thousands of Irish immigrants who had worked on the Erie Canal moved into the settlement seeking jobs. Families in the United States contacted relatives still in Ireland urging them to come to the new land for jobs and religious freedom.

In 1837 at least 1,700 Irish emigrants left home hoping to find work, food and freedom, crossing an ocean and half a continent. Working on the docks, in the quarry or on the Canal, they were lodged in shanties by their employers. They were fed, given a gill of rum (about half a cup) and 90 cents in scrip per day. The scrip could be used as money at a company store.

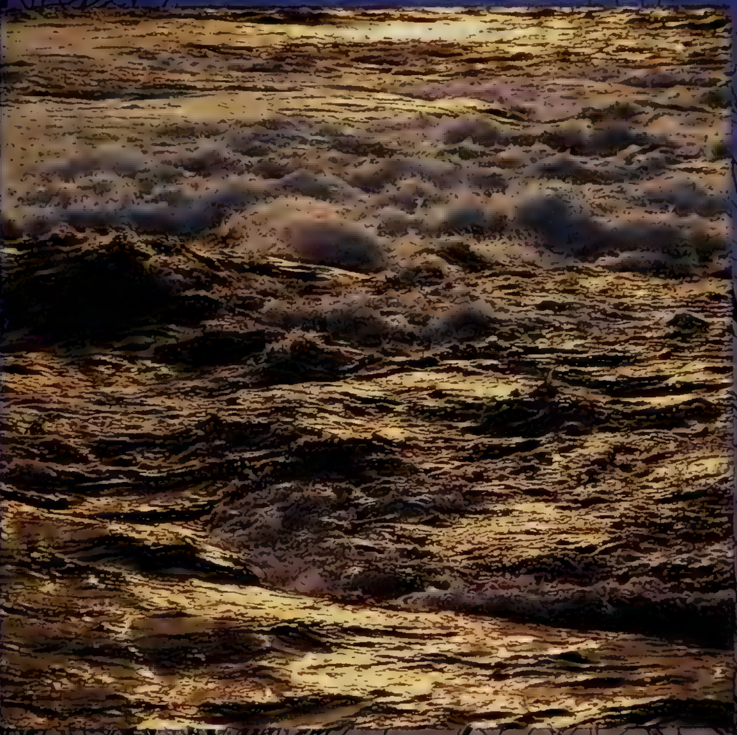
"There were German immigrants, too," according to Lee Hanson, "but the scrip could be used to buy land at $1.25 per acre. Most of the Germans bought farms as soon as they could. It really was the thousands of Irish immigrants who built the Canal."

In this harsh, impoverished, raw environment, old world family feuds ignited. Riots coupled with yearly outbreaks of cholera killed thousands. In 1838, 500 perished.

Money dried up during the national financial crisis of 1840, and work ceased on the Canal. Construction resumed five years later, and the Canal opened in 1848. Chicago's population had grown to 20,000. The Bridgeport area of Chicago took its name from the city's first stone quarry. The area remains home to many of Chicago's early Irish families.

HIGH TIDE IN THE HEARTLAND

by Tara McClellan



Flood damages cost Illinoisans an average of $250 million each year. That's more than the entire annual budget for the Illinois Department of Public Health. A whole community, Shawneetown, was once moved to prevent future flood damages. Recently, within one year, the Chicago metropolitan area was hit by two floods, both of which exceeded the magnitude of a flood expected to occur once every century.

Their Infinite Variety

In its most simple form, a flood occurs when a stream or river overflows its banks. A number of events act alone or together to create different types of floods with varying degrees of severity. Bruce Barker, with the Illinois Department of Transportation's Division of Water Resources, says the most common cause of flooding is large and widespread rainfall that might be triggered by a line of slow, intense thunderstorms.

Another type of flood is the ice flood which Barker says is an annual event on the Mississippi River near the Quad Cities. Near the end of winter when ice-covered streams start melting, the ice breaks and forms dams which cause flooding. Water soon breaks the ice dam, but the ice merely flows further downstream and the process repeats itself. (Barker says scientists are working on an experimental project on the Kankakee River in which warm water from a power plant is diverted through the cold river to prevent ice jams.)

In *The Handbook of Applied Meteorology*, Krishan P. Singh from the Illinois Water Survey (IWS) enumerates the other factors which work individually or jointly to cause floods: intense storm precipitation, rainfall over snow-covered areas, snowmelt, rain occurring on water-saturated ground, a succession of heavy storms and dam failure. The severity of the flood depends on the intensity and combination of the factors causing it.

The Waterlogged North

While flooding occurs year-round, Barker says that, statewide, flooding seems to occur more during the spring and summer because warm, humid storm masses from the Gulf often combine with northerly cold fronts to dump lots of rain on Illinois. However the northern part of Illinois gets at least half of its annual floods during the winter, partially because the frozen ground increases water runoff. And according to a study on flood trends done by Stanley Changnon of IWS, Illinois' climate has become increasingly cooler and wetter, producing more winter floods and longer floods, especially in northern Illinois.

Flooded side street in Edgewater District, Chicago, Illinois (Courtesy: Illinois Geological Survey)

Mother nature's cruel mood swings aren't the only factors affecting flood damages. Man has exacerbated the problem. Erosion from construction, wetland development, floodplain filling, stream alteration and inadequate bridge construction have increased the damage that floods inflict. Overall, urbanization may be the worst culprit. When land is developed it often loses its ability to absorb water as the sponge-like ground is replaced with concrete or other impermeable surfaces that increase water runoff.

This helps explain why northern Illinois, especially metropolitan and suburban Chicago, is highly susceptible to flood damages. It's an area with several rivers (and, of course, Lake Michigan) whose floodplains have been filled, leaving floodwaters nowhere to go. Other vulnerable areas in Illinois include floodplains near the Mississippi, Illinois and Ohio Rivers. Barker says floodplains near the Ohio Rivers are highly prone to flooding since that river's level can vary fifty feet from normal stages to its highest flood stage.

Northern Illinois' flood susceptibility dates back to at least 1673 when records show that explorers Marquette and Jolliet had to evacuate camp there because of floods. Unfortunately history repeats itself.

Northeastern Illinois was recently hit by two history-making floods. In September and October of 1986, and again in August of 1987 the Chicago metropolitan area was severely flooded. Mike Bender, with the Water Survey, says that each of these floods was worse than a 100-year flood, a flood that is expected to occur once every century. Two 100-year-plus floods occurring within twelve months of each other was even more astonishing.

The 1986 flood resulted from continual substantial rainfall over nearly two months. The Des Plaines River flooded and damaged around 2,200 homes and 150 businesses, costing approximately $42 million. Roads were closed, traffic disrupted, and 3,300 people were evacuated from their homes.

Unlike the previous flood, the 1987 flood resulted from almost 13 inches of rain falling in a concentrated area in a matter of days. Nearly one inch of rain fell on O'Hare Airport within three minutes. More than 16,000 homes and businesses in Cook and DuPage Counties were damaged at a cost of $100 million, and about 300 vehicles were stalled on expressways flooded with up to six feet of water.

While floods cause a lot of heartache and financial damage, they can also have positive effects on the environment. When flood waters recede from low-lying floodplains, they leave rich nutrients and sediment which often produce valuable forests.

Stemming The Tide

Over the years communities and governments have initiated flood controls to curb flooding's adverse effects. There are basically three types of flood controls: structural, nonstructural, and a combination thereof. Structural controls include erecting structures like levees, dams, and reservoirs, or floodproofing existing buildings. The Flood Control Act of 1945 requires the state to help local governments with structural flood damage reduction projects.

Nonstructural controls like zoning regulations and restrictions on the acquisition and use of floodplains were initiated around 1975, according to Barker. These help monitor floodplain development and ensure that the area will be used appropriately. For instance, low-lying floodplains are not good for residential purposes but could provide excellent recreational uses. While these type of controls do not prevent flooding, they decrease the amount of damage it causes.

A recent report by a gubernatorial Flood Control Task Force recommended initiating even more stringent controls in northeastern Illinois. The task force was appointed in 1987 to determine how to minimize future flood damage after the record-breaking 1986 and 1987 floods inundated that area. The group's recommendations included: prohibiting new construction in the area's 100-year floodway, requiring new construction in the floodplain to provide additional storage for stormwater runoff, and allowing Chicago's collar counties to increase property taxes to fund the execution of stormwater management plans. (Implementing all of the task force's suggestions would cost $2.4 billion.)

Flood Information

In order to control flood damage, planning bodies must understand existing flood hazards and the flood history of the area in question. In the mid-1970s the state required the Water Survey to maintain a central library of the best available information on flooding throughout Illinois. This library is the Illinois Floodplain Information Repository.

According to Bender, who helps manage this information, the basis of much of the Repository's data is regulatory studies done by the Department of Transportation's Division of Water Resources and flood insurance studies done by the Federal Emergency Management Agency. In all, the Repository offers nine different types of studies or reports on floodplains, flood insurance, flood hazards, flood controls, dam safety, and the like.

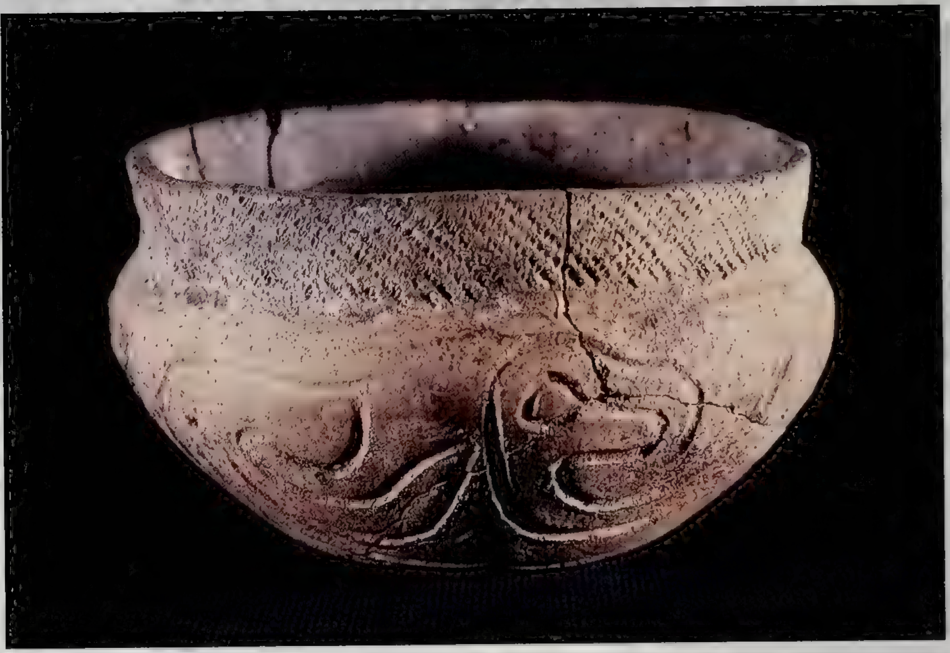
Bender says the Repository's customers are "very cosmopolitan" and include consulting engineers, community officials, financial lenders, appraisers, realtors and prospective property buyers. Usually they are seeking information to clarify a property's floodplain perimeters or to determine the property's floodplain elevation, since there are restrictions on building in floodplains and on securing insurance for structures in these areas. (To get information from the Repository, call the Water Survey at 217/333-2304.)

Illinois has taken important strides in controlling floods. While the rate of increase in flood damages has slowed, overall losses are mounting. The climatic outlook isn't favorable according to Changnon's 1981 flood trends study. Since floods can't be abolished, continually improving flood preparedness and flood controls seems to be the key to a drier future for Illinois.

Building a barrier: Illinois River at Peoria (Courtesy: Illinois Water Survey)

BURIAL TREASURE: THE ELIZABETH BIRDS

by James Krohe Jr.

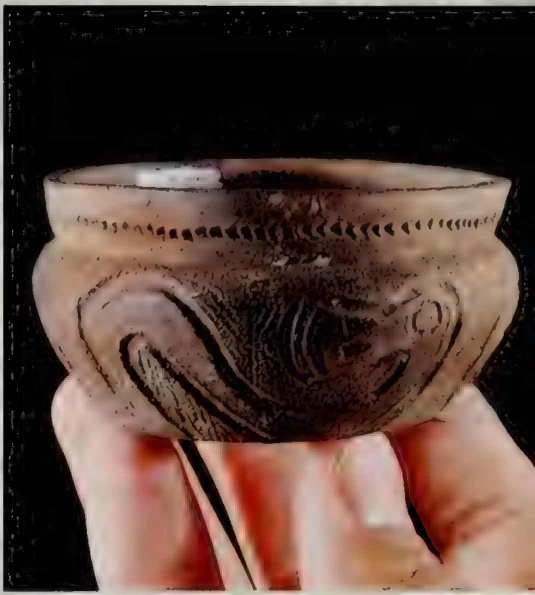


Roughly 2000 years ago, at about the time of Christ, the body of a child not yet a year old was laid in an earthen pit atop a bluff overlooking what would later be known as the Illinois River. Next to the child were carefully stacked 20 vessels made of fired clay, flattish bowls and jars of assorted sizes and shapes, all profusely decorated with shapes and simple pictographs inscribed into their sides.

Sacred Precincts

Twenty centuries later, archaeologists working with the Center for American Archaeology in Kampsville, Illinois, unearthed those remarkable ceramics from the pit they designated Burial 13 Feature 6, Mound 7, at the Elizabeth site in Pike County. The discovery was made in 1984, part of a series of digs being made in an Indian mound group in advance of major highway construction. The site had been home to peoples of the Havana culture who thrived during the Middle Woodland period of Illinois prehistory that began approximately 100 B.C. The vessels themselves were of the Hopewell design (named after the Ohio site where their type was first found). This design was widely disseminated during the centuries when Middle Woodland peoples dominated the eastern half of what is now the United States.

"It is really a unique cache of pottery vessels," explains Ken Farnsworth of the Kampsville Center. Pottery of any kind is a rare accoutrement of Indian burials of the period. In perhaps two thousand such burials that have been excavated in the lower Illinois River valley, he says, only a dozen or so such objects had previously been recovered. Their role in the burial rituals of the time is unclear. The pottery, like the body of the infant found next to it, may have been an offering initiating the burial site as a "sacred precinct."



Indian ceramics of the time were decorated variously. Twisted cords were sometimes pressed into the wet clay before firing. (Cords were also wrapped around sticks or small paddles to achieve different effects.) In addition to cord-marking, artisans used punches or stamps to incise designs into surfaces before firing.

During the Early Woodland period, those patterns consisted solely of geometric figures and straight lines. As the Middle Woodland period dawned, Farnsworth explains, "Prehistoric man discovered the curved line." Vessels of Hopewell design began sporting designs of a new variety and style. Of the 17 Hopewell vessels found in the burial pit at the Elizabeth site, for example, 11 bear the images of birds.

The Illinois Flamingo?

Animal motifs were common in Indian art. The pots and pipes of the Middle Woodland Indians, like those of their successors the Mississippians, were carved and scribed into the likenesses of diving ducks, frogs, bears, cardinals, and hawks. John James Audubon, who later painted some of the birds he saw while in Illinois in 1810 and 1812, merely echoed in a different medium the inspiration of these unnamed Indian artists. The carved effigy of a raven that adorns a stone pipe found in Hardin County, for example, is far from the crude representations commonly associated with "primitive" art. Instead it is an artfully stylized version that anticipated by centuries much of what we know as modern sculpture.

Two kinds of birds festoon the vessels found at the Elizabeth site. One is spoon-billed, the other displays a hooked beak. The images are abstract and hard to characterize with precision. David T. Morgan, a ceramics expert who authored a monograph about the finds, notes that the portraits may represent different species of each type of birds or different renditions of the same species.

The hook-beaked birds for example would seem to be raptors of some kind, one of the predator species whose sharp beaks are used to tear flesh. Carrion-eaters such as turkey vultures would have had a natural association with Middle Woodland burial practices. Bodies of the dead were not always buried immediately but were placed in open central tombs,

sometimes to be transferred to an adjacent site for burial, sometimes to be interred permanently in the tomb when the tomb was eventually filled. Until then, carrion birds could feed freely upon the remains.

Morgan, however, argues that the looping, thin necks of the Elizabeth birds suggest not a raptor but some kind of hook-beaked wading bird, such as a flamingo. Yes, a flamingo. Morgan admits that this interpretation is extremely speculative, but it is not impossible. There was much trade between the Illinois River valley and the Gulf of Mexico during this period. Among the objects recovered with the Hopewell vessels in the burial pit, for instance, were large marine shells from the Gulf area used as drinking cups.

Might there have been trade in flamingoes as well? The bird might have been prized for its bright pink feathers, which conceivably could have been used as ornament. After all, the bird is popular among modern Illinoisans, who decorate their lawns with plastic versions of it. There is no other evidence that the flamingo was ever present in prehistoric Illinois, however, and Farnsworth for one thinks it unlikely that the hook-beaked birds on the Elizabeth site vessels are flamingoes.

One spectacular pink-feathered wading bird that almost certainly was known in Illinois 2,000 years ago was the roseate spoonbill. "There is one definite representation of a roseate spoonbill in Hopewellian art," Farnsworth says, "a pipe made of coal from Ohio." The headless body of such a bird was even found beside a buried child at a Middle Woodland site in the lower Illinois valley.

Scott Robinson, an ornithologist with the Illinois Natural History Survey, notes that roseate spoonbills normally frequent the brackish waters of the Gulf coast, but that stragglers used to move up the Mississippi valley in late summers to feed. Robert Ridgeway, one of the great names from the Survey's early years and author of the indispensable 1895 *Ornithology of Illinois*, reported that roseate spoonbills were regular visitors as far north as the American Bottom, opposite St. Louis, until 1859.

A Culture At The Center

But why portray the spoonbill and not any of a dozen other birds? The spoonbill has no known association with Middle Woodland mortuary practice, nor were pottery vessels bearing its likeness used solely in burial ceremonies. The bird's long spatulate bill is distinctive, but the spoonbill is not the only bird then common in Illinois that had one. Morgan even suggests that the triangular designs that adorn one of the bird vessels represent webbed feet, and that the bird thus depicted may in fact be some kind of duck.

To the layman these disputes may seem like a tempest in a clay pot. But these ceramics offer clues to the ways this vanished culture saw nature, life, and death, not just in the Illinois valley but across much of the continent. Farnsworth speculates that these particular pottery styles originated in Illinois. They were disseminated (sometimes in the form of the vessels themselves, via trade) as far afield as Louisiana, Ohio, and Michigan, making Illinois an important artistic center. "Whatever they meant, these designs were pretty important for that ritual," explains Farnsworth. "To have pots with these designs clearly was the right way to go into the next world."

Middle Woodland Ceramics from the Elizabeth site are on permanent display at the Illinois State Museum in Springfield.

**All photos courtesy of Ken Farnsworth*

Current farmstead

(continued from p.3)

confirms Schicht, who adds that while the long-term global climate trend may be toward a drier regime, the last few years in the Bottom's drainage area have been among the wettest on record.

Public health as well as public property is also vulnerable to the unintended effects of exploiting the Bottom environment. The French learned that lesson when the water that backed up behind their mill dams stagnated and bred diseases. More recent inhabitants worry that the indiscriminate dumping of toxic substances onto the Bottom's permeable soils might be poisoning groundwater. The Water Survey is cooperating in a study to identify past industrial sites which might be toxic hot spots.

Bottoming Out

Any Indian ghosts who walk today among the mounds of the Bottom, in short, would hardly recognize the place. Pioneer-era bottomland forests were cut for steamboat fuel or cleared for farms; the original non-timber Bottom vegetation was probably destroyed by 1850. Some 40 percent of the area's wetlands have been drained or filled. Old meander lakes such as Goose Lake are gone; others such as Pittsburgh and Horseshoe Lakes are much reduced in size, and there is so little water standing in Grassy and Smith lakes that today's mapmakers mark them as marshes.

In 1842 Charles Dickens visited this area on his way to view Looking-glass prairie. He described the temperature, not as hot, but as if the area were on fire. All he could see was mud, mire, brake and brush on "the unwholesome, steaming earth." Everywhere the air resounded with the loud chirping of frogs. Today the chirping of frogs has diminished and given way to the hum of traffic and tractors. Isolated wildness, however, still remains to provide clues to the past. Virginia bluebell, mayapple and green dragon attest to the once plentiful bottomland forests. Rainfall-flooded winter wheat fields become vast marshes filled with ducks, herons and egrets. American lotus still blooms in small lakes and ponds in the summer.

The Bottom's riches, in short, have not yet been totally spent. The area recovered from the mistakes the Indians made in husbanding their resources. With luck and some effort, it can survive ours as well.

Contributing to this article were Michael Jeffords and Susan Post.

(continued from p.6)

Other Mallardfest events are examples of how Whistling Wings tries to diversify its activities and publicize its operations. Mallard hens that have outgrown their breeding years are sold to field trial associations, feathers and infertile eggs are sold for decorative purposes, duck meat and duck sausage are available at Whistling Wings' office, and duck manure is sold as fertilizer. The*Wall Street Journal* did an article on the whether bat guano was superior to Whistling Wings' duck guano...the jury's still out. Visitors to the farm can also buy numerous duck items such as shirts, pins, and mugs.

Mallard sales have increased fairly steadily over the years with little benefit of advertising. Most business comes from word-of-mouth. Whistling Wings prides itself on quality "flighting mallards" with "long wings, correct size, true color, and good temperament," as the brochure reads.

Operating Whistling Wings wasn't always so easy. In the farm's formative years, Whalen had to develop his own techniques to raise mallards, often on a trial and error basis. Whalen was the only person who had ever exclusively produced mallards; he had no predecessors to look to for advice or answers to questions like how much humidity duck eggs need. (Before the modernized incubators, Whalen's family used to throw buckets of water on the eggs to keep them moist.)

"We took it day by day," he says.

The farm has undergone several changes since then. Four breeding groups, instead of the original one, produce eggs year-round unlike the early years when hatchings only occured in the spring and summer. Whalen was able to accomplish this after learning how to use food and light to control when hens lay eggs. The farm has also acquired new hatchers and incubators with a sophisticated alarm system that pages workers if something is wrong with the eggs or machine. While family still comprises much of the workforce, the farm now employs ten people and covers about 700 acres, much of which is used to grow duck feed.

Bill Whalen predicts increased success for the farm. With less land available for hunting, he believes hunting clubs will become more popular and will boost mallard sales.

The duck market looks decidedly bullish.

AIRMAIL
RUSH

Clockwise from top left: *Ducks in shipping crate; Shipping crate; Wetlands where ducks are released to become adults*

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THE NATURE OF ILLINOIS

Fall 1989

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The Society Page

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We are the Society for the Illinois Scientific Surveys, established to foster an understanding and appreciation of Illinois' heritage of natural resources. We do this by promoting the work of Illinois' Scientific Surveys - the Natural History, Water and Geological Surveys, as well as the Hazardous Waste Center.

In the nineteenth century it was the Surveys and their predecessor agencies that first explored, researched and catalogued the fish, wildlife, mineral and water resources of our state. What follows are some recent research projects undertaken by these gifted and hard-working professionals:

> Acid rain, floodplains, **endangered species**, Great Lakes pollution, climate changes, **Lake Michigan shoreline losses**, bats, dam failures, **pollution and national monuments**, groundwater protection, river ecosystems, **bald eagles**, aquaculture, tornadoes, **air quality**, water supplies, lake eutrophication, **winter storms**, nature preserves, flooding, **drought**, the Asian Tiger mosquito, **restoration of the I & M Canal**, streambank protection, soil erosion, **coal desulfurization**, oil and gas recovery, seismic risks, **mine subsidence**, lake sedimentation, surface water pollution, **recreational lake protection**, mineral resource development, fluorspar, **landfill design**, underground injection control, aggregate mining, **safe siting of large facilities**, agricultural pests, agricultural meteorology, **inadvertent weather modification**, severe weather, gypsy moth, **crop pests**, farmland wildlife, urban deer, **tree and plant parasites**, coyotes, cats, **the prairie chicken**, bobcats, river otters, **chemicals in the environment**, woodland management, pesticide toxicity, **aquatic toxicology**, fish genetics, neo-tropical birds, **cave ecosystems**, bird navigation and airplane hazards.

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Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

The Governor is presented the Society's Natural Resources Basket by Gaylord Donnelley

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Gray tree frog getting a grip on fall.
Photographer: Dr. Michael Jeffords.

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Editorial Staff
Jane A. Bolin *Editor*
Jane Christman *Assistant to the Editor*
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DUNE

by James Krohe Jr

Dead River scene

No place is less like Illinois, and at the same time more typical of it, than Illinois Beach State Park. This stretch of sand dunes and scrub oaks in Lake County is home to cactus rather than corn, a place where strollers are serenaded by surf rather than the rustle of soybeans in the breeze. Yet Illinois' Lake Michigan shore was sculpted and shaped by the same forces - wind and water acting on glacial debris - that made the rest of the state.

Playground and Preserve

Illinois Beach today is a combination playground and preserve of more than 4,100 acres to which some 2.5 million people flock annually - far more than visit any other Illinois state park. Illinois Beach is also a vast archaeological ruin. These seven miles of beach and dune are typical of terrain that once lined virtually the whole of modern Illinois' Lake Michigan shore. As lake levels fluctuated over the centuries, the lake built and then abandoned a succession of sand and gravel beaches. Those old beaches survived and today form parallel ridges separated by low-lying swales. Inland, this ridge and swale topography becomes host to dry sand prairies and marshes in turn, while at the water's edge it gives way to low-lying dunes of wind-blown sands.

Illinois Beach has always been a popular spot for excursions and summer homes. Its appeal is partly its exoticism and partly its simplicity. The vistas here consist of sun, sky and water whose sparseness seems infused by almost Zen-like repose.

Apart from the dunes, Illinois Beach's most distinctive feature is the mile-long Dead River. Dead River belies its name in important respects. It is not a river - it is a narrow pond - and most seasons of the year it is quite lively, being home variously to spawning fish and migratory waterfowl. Dead River does not, however, move very fast or very far. Its outlet into Lake Michigan is usually plugged by a sandbar until backed-up water behind the bar chews through it to send Dead River gushing into the lake. After that the lake immediately begins to pile up sand again like a beaver rushing to cram sticks into a breach in its dam.

Famed landscape designer Jens Jensen championed the preservation of Illinois Beach as early as 1888. Local citizens lobbied in earnest for its designation as a state park in the 1920s, but it was not until 1948 that the section of shore near Dead River was acquired and opened as Illinois Beach State Park. That original parcel was expanded, too, beginning in the 1970s when the state began acquiring miscellaneous properties that comprise what is now known as the north unit of the

Egret fishing in Lake Michigan surf

park, acquisitions that nearly doubled its size.

As a recreational resource, Illinois Beach is unmatched. The park's south unit offers a thousand-foot swimming beach with bath-houses, boating and camping facilities, even a motel-style lodge. The north unit is the site of the 1,500-slip North Point Marina, which will be the largest on Lake Michigan when it is completed in April of 1990.

Downcoast from the lodge, the park is devoted to more passive pursuits. A nature area is open to the public, some half-million of whom hike, sunbathe, or go birding along the beach, among the dunes, or on the four miles of trails (equipped with lookout platforms and interpretive stations) provided by the state's Department of Conservation. The southernmost 1,100 acres of the site were officially designated a nature preserve in 1964 - the first such site in the U.S., according to site superintendent Bob Grosso. That tract is reserved for research and is accessible only by permit.

Exotic Illinois

As many as 60 plants and animals recognized as threatened or endangered in Illinois may find refuge at Illinois Beach. No fewer than 16 natural community types are represented here, from the dune face to ponds to savannah-like open woods. It is not only Illinois' most exotic natural place, but also perhaps its most varied. Birds of the farm field such as the Eastern bluebird nest just yards from where shore birds such as the piping plover stop to feed, and fen-loving plants such as the fringed gentian grow only yards away from interlopers from the arid West like the prickly pear.

A walk inland from the shore is a quick course in natural plant succession that ends in the climax community of the scrub oak forest. The sandy soil of these ancient beaches is an inhospitable habitat for a tree, the more so since these Hill's oaks and black oaks must endure not only drought and wind but fire. Park staff burn the nature areas every three years as part of their management plan, mimicking the natural prairie fires that regularly burned off undergrowth and more fragile competitive tree species. Oaks typically dominate these open savannahs, explains Ken Robertson, botanist in the Illinois Natural History Survey's Center for Biodiversity, because they do well in surviving fire. (Among the other species that do well in spite of the burning, jokes superintendent Grosso, are the mosquitoes and the poison ivy.) The result is twisted trees that are the antithesis of the majestic oaks familiar from more clement corners of the state. Some of the oaks in the Illinois Beach scrub forest are known to be at least a century old, yet have only attained heights that many a yard tree reaches in a tenth of that span.

Indeed, for all its seeming delicacy, Illinois Beach offers some brutal environments for living things in the state. A beach may be a sublime habitat for the human animal on a balmy day, but for a plant it is a hell of pounding waves, scalding sun and wind. Even on the foredune, immediately inland from the shore, few plants can survive, much less thrive. The plant pioneers that homestead on these treacherous frontiers are a hardy bunch - beach pea, common bugseed, sand reed, seaside spurge, marram grass.

The interdunal plant environments are less punishing, and membership in

Blazing star flowers blown down by the wind

Dune-binding grass blown by the wind

those communities is more numerous. Two conspicuous members of the inhabitants of this niche are the creeping juniper (a shrub that is more branch than leaf) and the bearberry. In the poorly drained terrain typical of a post-glacial landscape, differences in elevation as small as one foot can make big differences in soil moisture and thus the roster of species. The results are sometimes anomalous. The sandy soil may look like a desert, but water is usually only feet away, in underground formations saturated by the nearby lake. Some dunes grasses send roots down ten feet; so do cottonwood trees that thrive in the park, trees that usually are found huddled in Illinois' moist stream bottoms.

Few of these plants are rare outside Illinois, says Robertson. Most are so common on the coastal plains of the eastern U.S. that the only thing a botanist from Cape Cod would find strange here would be the accents of his Illinois hosts. What is rare is the variety of habitats. The nature preserve proper, reports Robertson, astounds even first-time botanizers familiar with the rest of the park, who find a "markedly different world down there."

The diversity of life in all groups is immense. Plant species so far identified within the park number in the hundreds. "It's always been a place for Natural History Survey staff to collect," notes Dr. Warren Brigham, director of the Center for Biogeographic Information. "Dead River in particular has often turned out to be the place from which new species are described." Not just species new to Illinois, but new to science, as was the case with the aquatic beetle collected by Brigham in the 1970s. Ecologically, Illinois Beach is an outpost of species whose ranges are centered to the east, north, and west. It is this overlapping of ranges that explains what Brigham calls the "phenomenal" richness of life along the shore.

Lake Michigan as Architect

While harsh, the dunes environment is inherently fragile. The active dunes that line the shore are made up of what the geologists poetically call Aeolian sands, after the Greek god of wind. The lake winds constantly nibble at the dunes. Where a dune's flank is left unprotected by plants, even light winds can lift the sand by the bucketful, leaving hollows known as blow-outs. (Some visitors have found that blow-outs are ready-made sunbathing booths.)

The near shore in particular is forever being redefined. A storm can flatten a dune overnight, only to rebuild it again over the following weeks and months. In this way a dune may disappear but the dunes persist. Such changes can be inferred from the nature and sequence of the sediments left behind by the lake. Where the botanist sees habitat, in other words, the geologist sees a history book. Ardith Hansel, geologist with the Illinois Geological Survey's Quaternary Framework Studies Section, is part of the team that is studying core samples and other data from this beach record. (Among the preliminary findings: The beach remnants that cover today's shore plain are no older

Cottonwood leaves, a dune-binding species

than 3,000 years.) Illinois Beach is particularly valuable, says Hansel, because, "It's the one area in Illinois where you can access the Late Holocene lake record. It's an opportunity to study changes through time."

Such investigations see into the future as well as the past. Charting the cycles of Lake Michigan's rise and fall will help public policy makers anticipate shore protection needs. "We're trying to determine what lake level fluctuations have been like," explains Hansel, "to ascertain if the short, 90-year historical record is a good analog for the past 4,000 years or so."

Lake Michigan is a fussy architect, forever fiddling with its designs. Waves constantly chew away sands and gravels from one spot of the shore and move them to another, eroding one section of shore while it builds another. This endless redrawing of the shoreline can be inconvenient to humans. Housing subdivisions, even whole villages once stood off the town of Winthrop Harbor near the north unit in what is now several feet of water.

During 1985-86, when the lake levels stood at record highs, the shore along the north unit was receding at a rate of 80 feet a year. For a while, in fact, there was no beach at Illinois Beach.

During those fretful months, storm waves would overtop the foredunes, crashing into the swales behind them like soldiers swarming into the enemy's trenches. "We never had interdunal ponding before," recalls superintendent Grosso. Plant communities that quickly responded to the damper regime offered a perfect laboratory of plant adaptation, but the lake dropped precipitously before a field study could be mounted, leaving both the plants and the scientists high and dry.

How Lake Michigan goes about making and remaking its shore is a puzzle that has long fascinated researchers at the Geological Survey. Chief among them is Charles Collinson who after nearly 18 years of study is regarded as the guru of Illinois lake watchers. During a high-water phase in the mid-1970s the old Stratigraphy and Surficial Geology Section maintained a field research station at Illinois Beach, which offers one of the longest stretches of unarmored, untampered with shore left on the Illinois side.

Oasis and Commerce

What the lake destroys, however, it usually rebuilds. The graver threats to the Illinois lake shore above Chicago have always come from land. The area's natural advantages - its scenic appeal, its easy access to shipping and lake water, its proximity to major population centers - have always been exploitable as economic advantages as well. Often these commercial intrusions were benign; in the nature trails today one can see the relic stone piers from a narrow gauge railway that used to carry ice cut from the Dead River to nearby Waukegan. Today the site is ringed by factory sites, housing development and power plants. That splendid sense of isolation one feels inside parts of the park is only an illusion. Construction just outside the park boundaries has changed water regimes inside the park, although not yet significantly, and a sentry line of monitor wells stands guard in case waste from an asbestos dump on adjacent property seeps into the park's aquifers.

Barring such unhappy intrusions, Illinois Beach State Park will survive as a place where one can leave Illinois without having to leave it. As Ken Robertson says, "It's a markedly different world." ■

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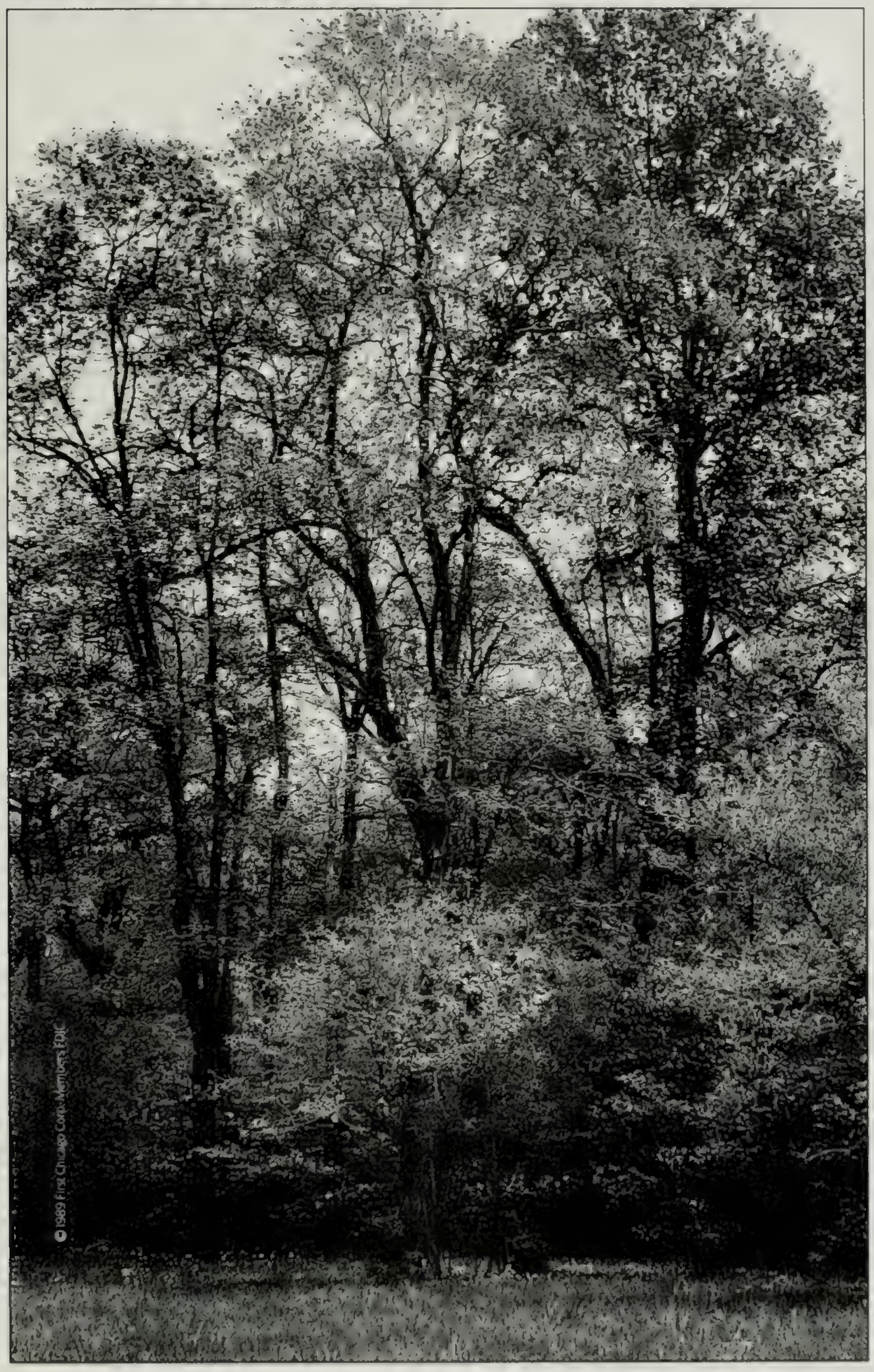

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Although our role in the shaping of Chicago's skyline seems to get all the press, First Chicago has long supported the vigilant stewardship of our natural resources. ■ In less than a century, Illinois has lost 72% of its forestland alone. We applaud the efforts of groups such as the Illinois Scientific Surveys and The Nature Conservancy, who study and help preserve our state's prairies, wetlands, forests, open lands and wildlife.

FIRST CHICAGO

FIRST AND GAINING.

ILLUMINATING NATURE

As important to a scientist as research are the pictures that illustrate the path of discovery traveled from first inquiry to end result. Earliest scientists involved in the beginnings of today's Illinois Natural History Survey (INHS) record their conviction that illustrations must accompany words if science is to be interesting to and understood by lay persons.

Germination of the Survey is traceable. But stories of the people who made the pictures are sporadic and brief at best. The only authentic source is annual "Bulletins", which actually were small, generously illustrated books presented first in 1869 as progress reports prepared for sponsors or governing boards. The Bulletins were written by scientists who usually did not name the creators of their illustrations. Lost in history are the names of many of the talented people who walked the paths of discovery with scientists. This article salutes the work of those few who can be identified.

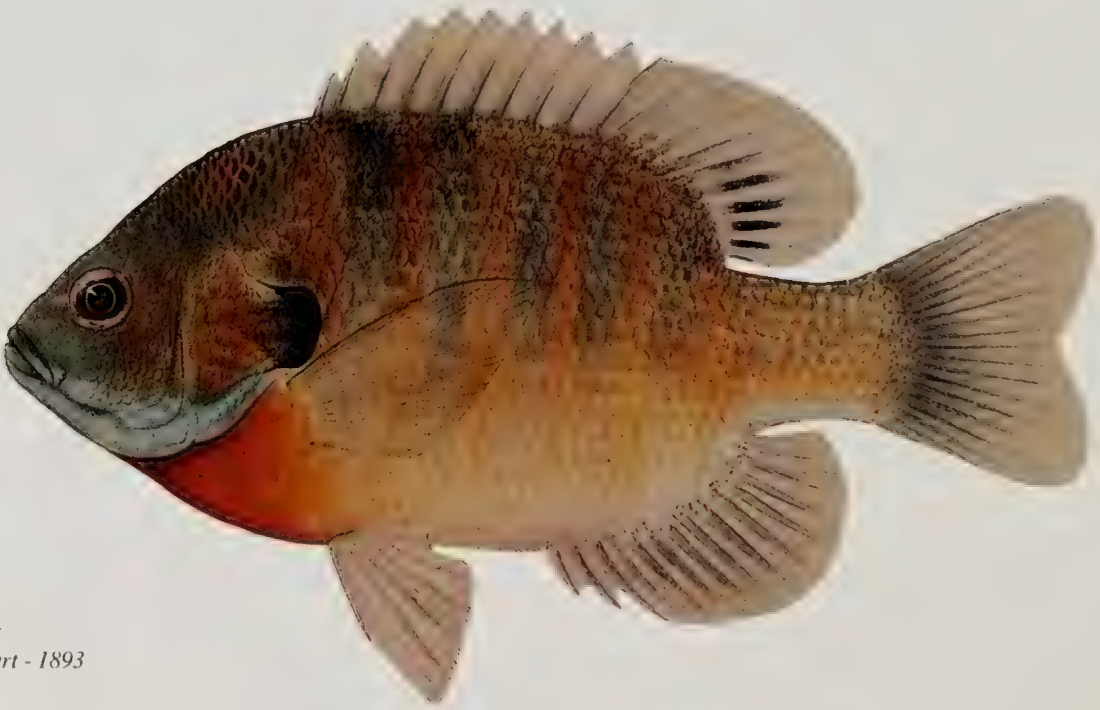
The Need for Pictures

Pressure to establish an organized group of scientists to sort out and explain the habits of all biological "things" was powered by educators, agriculturalists and horticulturalists. To inform their constituents, these leaders needed pictures and words.

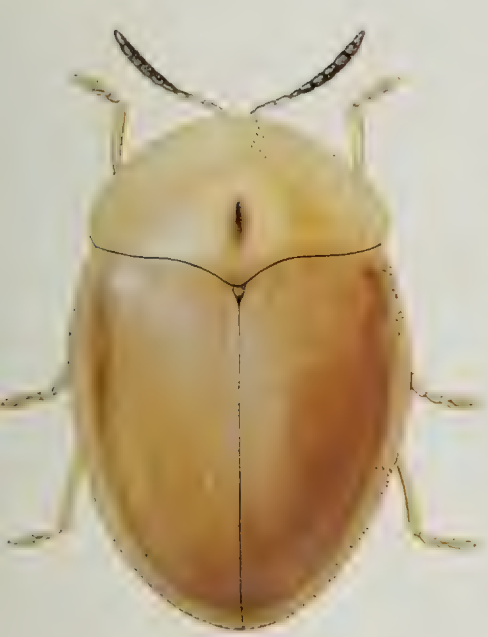
Benjamin Walsh was a classmate of Charles Darwin's in England before coming to Illinois in 1838. Walsh died as the result of a tragic accident in 1869 before he could present an Annual Report as the state's first Acting Entomologist in that year. Walsh' scientific legacy is astounding. His crusty quotes are priceless. Often he chided his peers for seeing science as a "mental toy" deprived of practical application. Prepared before his death, his 1869 Annual Report says, "If I merely succeed in enticing away a single young woman from her mawkish novelettes and romances into the flowery paths of Entomology, or induce a single young man, instead of haunting saloons and lounging away his time at street-corners, to devote his leisure to studying these tiny miracles of perfection which the people of the United States call 'bugs,' I shall think that I have not written altogether in vain."

Walsh had little success getting the State Entomologist's office properly funded. His acerbic tongue lashed officials who could "find millions to build a capitol building and not enough to produce a basic science manual for young students of science." Walsh drew his own sketches and sent them to an engraver in St Louis.

Doctor William LeBaron, who succeeded Walsh as State Entomologist in 1870 said, "Next in value to a collection of



Bluegill watercolor
by Lydia Moore Hart - 1893



Tortoise Beetle, gouache, by John Sherrod - 1980

the insects themselves, are correctly drawn figures." LeBaron's 1874 Report declares that the study of natural history shall constitute one of the branches of education to be taught in the public schools. LeBaron's illustrator was Missouri's entomologist.

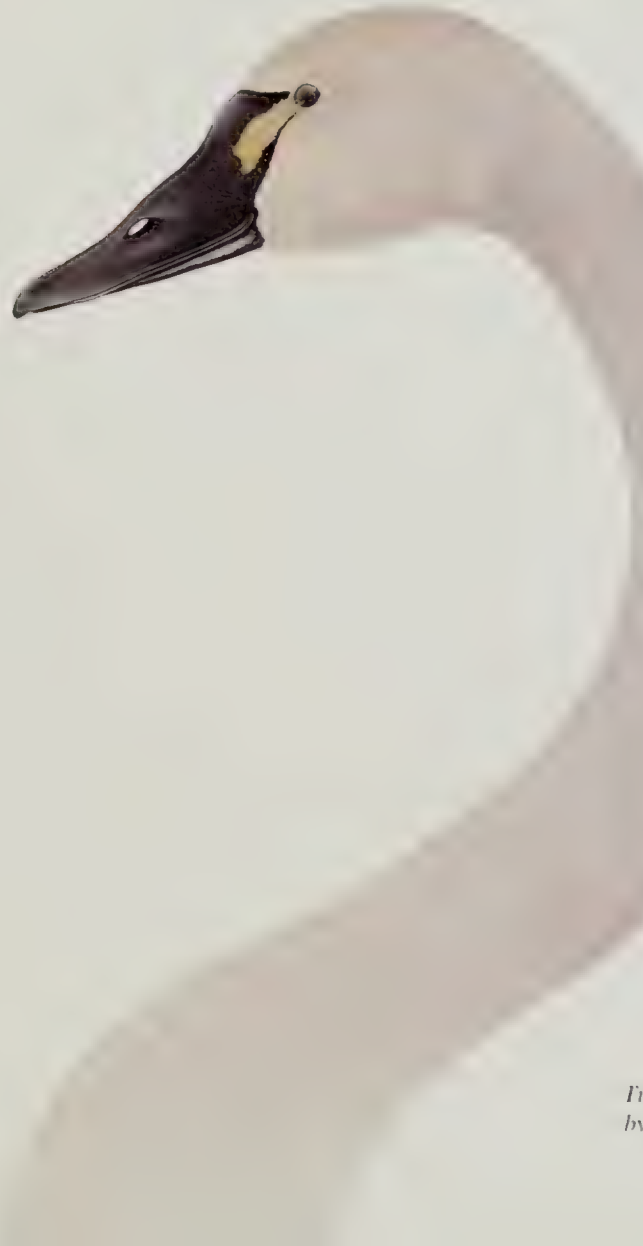
Stephen Alfred Forbes became the fourth State Entomologist in 1882. He was involved with each of the seeds that eventually became the INHS. They were the Illinois Natural History Society (established 1858), State Entomologist's Office (established 1867), and the Illinois State Museum of Natural History (established 1872). Forbes was Curator of the Museum in 1877 when the state split the three elements, moving "History" and "Museum" from the university at Bloomington to Springfield and allowing the associated laboratory to become the Illinois State Laboratory of Natural History.

Forbes was head of the Laboratory, teacher at Illinois State University and State Entomologist when he accepted a faculty job at the institution that became the University of Illinois in 1885. He moved the Laboratory to Champaign, retained the job of Entomologist and taught Zoology at the University. During his 60-year career in science his insatiable curiosity took him from the study of insects to fish, birds and mammals. Forbes was a masterful public speaker and prolific writer. He valued illustrations believing that they could help make science interesting to everyone. Forbes was a self-taught genius, first head of the Natural History Survey - so named in 1917 - and years later, hailed as the father of ecology.

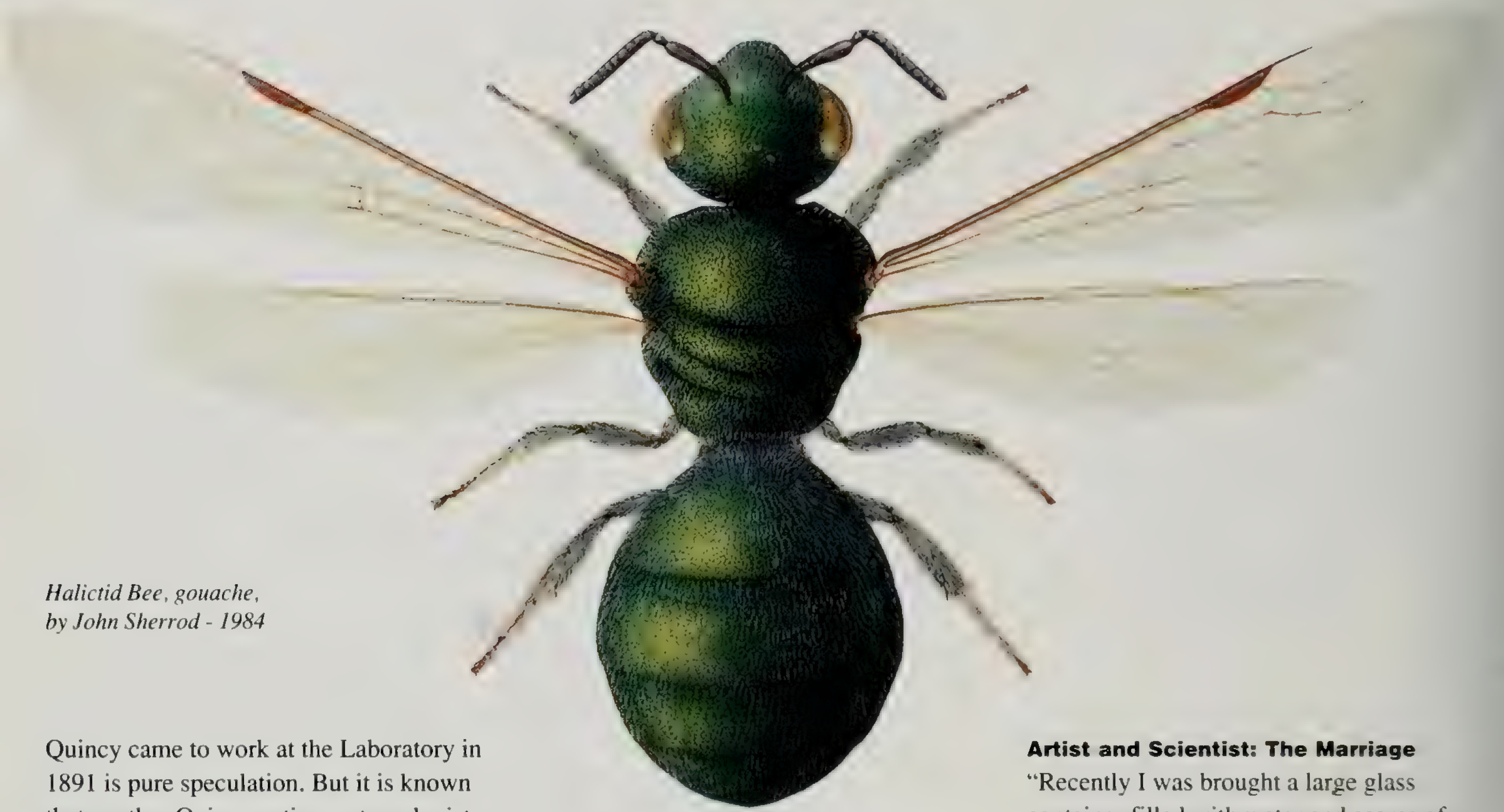
In the Eye of the Beholder

Scientific illustrations rarely are found displayed on the living room wall. Often the illustrator's job is to magnify the body part or cell structure of a species so that a scientist can take a better look at it.

Some of the most exquisitely executed scientific illustrations of all time emerged from the old Laboratory of Natural History headed by Forbes. The work of Lydia Moore Hart is miraculous, according to John Sherrod, illustrator at the Survey since 1978. Sherrod is trained as a medical illustrator and believes that Hart must have invented the tools of her art or at least adapted what she purchased. A single-hair brush and a quill sharper than a needle is Sherrod's description. How a native of



Tundra swan in watercolor by John Sherrod - 1987



Halictid Bee, gouache, by John Sherrod - 1984

Quincy came to work at the Laboratory in 1891 is pure speculation. But it is known that another Quincy native, entomologist Charles Arthur Hart, worked for Forbes in 1880. The conclusion is that Charles was Lydia's father or uncle.

Hart's technique is called stipple - endless numbers of dots made with a sharply pointed instrument. The density of ink used coupled with the size and spacing of the tiny dots define and shade the subject. In 1893, Hart and Charlotte M. Pinkerton displayed their work at the Columbian Exhibition at the Chicago World's Fair. Her signature remains Hart through 1900. But in his 1905 Bulletin Forbes credits L.M. (Hart) Green for illustrations. There is no record of Lydia Hart's whereabouts or the course of her life after the early 1900s. Pinkerton's only record is a few signed illustrations. Color plates by Hart and Pinkerton are used in Forbes' book *The Fishes of Illinois* published in 1908.

Crude by Comparison

The purposes and techniques of scientific illustration have changed little over the years. An artist's talent and ability to adapt tools seem to separate the flawless from the mediocre. In Sherrod's opinion nearly everything is average compared to Lydia Hart's superiority.

Carl Mohr was an artist who became a scientist specializing in insects and mammals. He learned to draw from his father, saying that he was an artist continually exposed to insect studies by operation of opportunity. As a science graduate student in 1927, Mohr was hired as a field entomologist by Dr. T. H. Frison who succeeded Forbes as Chief in 1930. Mohr's model was Lydia Hart. He used her stipple technique and added cross hatch: continuous parallel lines, running vertically and horizontally. The dots and the lines are executed so that the drawing shades from blackest black to lightest gray. Carl Mohr produced written and illustrated scientific studies for the Survey until the late 1940s.

Artist and Scientist: The Marriage

"Recently I was brought a large glass container filled with water and scores of fish of the same species," said Sherrod. The noses, eyes and tails of fishes can vary just as the physical characteristics of human beings do. Sherrod was to draw the "typical." After such a drawing is executed, a scientist reviews the work to be sure the illustration is correct. Another facet of the marriage is that no insect is considered "new" until it has been compared to some portion of the over six million insect samples on file at the Survey. "Illustration plays an invaluable part in that kind of scientific analysis," said INHS entomologist Dr. Michael Jeffords.

The Natural History Survey is increasingly involved in the effort to help science teachers develop and feed an appetite for learning about natural science. If the young minds of their students are to be captured and held, illustrations will play a vital part. ■

SURVEYING ILLINOIS

BIORHYTHMS

Model Pests

Illinois Natural History Survey (INHS) scientists are using supercomputers in insect control.

Illinois corn (Courtesy: INHS)

A recently developed mathematical model uses equations to describe what happens in a cornfield infested with European corn borer caterpillars. The corn borer is infected with a microsporidian disease that may ultimately control it. By changing numbers in the model, scientists can predict what will happen under various situations in a growing season. These predictions can tell farmers whether application of an insecticide is needed in addition to use of the microsporidian disease against the corn borer.

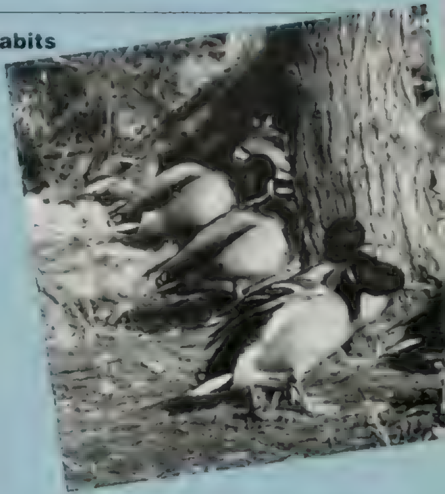
New Medical Entomologist at INHS

Robert J. Novak has been selected as the Medical Entomologist for the Survey's Center for Economic Entomology. Dr. Novak received his PhD from the University of Illinois in 1976, spent a two-year postdoctoral fellowship at Notre Dame University, and subsequently joined the Center for Disease Control; Bureau of Tropical Diseases, in Atlanta. He has also served in Puerto Rico, conducting research on vector-borne viral diseases. The top issue facing Dr. Novak in his new position is the introduction of the Asian Tiger mosquito into Illinois in scrap tire yards, as well as the possibility that other potentially health-threatening mosquitoes may use these piles as breeding grounds.

Survey Scientists Aid Champaign Schools

A new cooperative project between ten Champaign County elementary schools and the Natural History Survey will benefit more than 5,000 schoolchildren. The schools involved will turn from traditional science textbooks to materials developed by Survey scientists and elementary teachers. *Butterflies and Moths* for second graders, *Habitats, Food Webs and Food Chains* for third graders, and *Classification of Organisms* for fifth graders will be tested in the classroom in fall of 1989.

Changing Waterfowl Food Habits



Mallard ducks (Courtesy: INHS)

Over the past 50 years waterfowl in Illinois have come to depend on man for more of their food. The loss of aquatic plants in such wetlands as the Illinois River valley has resulted in major diet changes in several kinds of waterfowl. The last intensive food habits study was conducted in 1938-1940. The current study examined over 11,000 individual food samples from 14 species of waterfowl. Mallards, for example, now depend on such human-managed foods as Japanese millet, buckwheat and milo to the same degree they depended on aquatic plants in the 1930s.

Learning the River

The Natural History Survey has developed a new set of curricular materials: *The Illinois River: A Lesson To Be Learned*, for grades five to nine. The materials focus on the biology and ecology of the Illinois River and such problems as pollution and sedimentation. They will be distributed in conjunction with the Illinois State Museum's traveling exhibit, *Harvesting the River: Life and Work on the Illinois River*, or can be ordered directly from the Survey by calling Phyllis Dice at 217/333-6821.

The Illinois River from above (Courtesy: INHS)

CURRENTS

Rainstorm Data For Engineers

Engineers need to know maximum amounts of rainfall expected in a given area when designing highways, storm sewers, spillways and dams. They can now rely on definitive data for heavy rainstorms in Illinois developed by Illinois Water Survey (IWS) climatologists.

Published as Water Survey Bulletin 70, *Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois*, the report includes statewide maximum rainfall values for each season and for all seasons combined. It also contains sectional values and isohyetal maps.

To receive a copy, send a check or money order for $15 (includes postage and handling) to Publications, Illinois Water Survey, 2204 Griffith Drive, Champaign, Illinois 61820. Checks should be made payable to the University of Illinois, c/o Illinois Water Survey.

MOBILE OXIDATION
PILOT PLANT (MOPP)
ENR ILLINOIS DEPARTMENT OF ENERGY & NATURAL RESOURCES
SWS ILLINOIS STATE WATER SURVEY
HAZARDOUS WASTE RESEARCH & INFORMATION CENTER

MOPP trailer (Courtesy: IWS)

Water Survey aquatic chemist Mike Fleck draws sample of treated water in Mobile Oxidation Pilot Plant (MOPP) (Courtesy: IWS)

Saving Peoria Lake

Water Survey technician Ron Bell checks instream sediment sampler in Peoria Lake tributary (Courtesy: IWS)

Peoria Lake - the largest lake in the Illinois River valley and a popular recreational area - is almost completely clogged with sediment. Most of the lake can no longer be used for swimming, boating or fishing.

Illinois Water Survey researchers have proposed an innovative solution to the lake's problems: dredging sediment from the lake and creating artificial islands from the dredged materials. In a second study IWS is monitoring sediment carried by tributaries to the lake to determine the best locations for controlling incoming sediment.

Dredging benefits would include creation of improved aquatic habitats for fish and other animals and increased water depth for better recreational opportunities.

Mobile Unit Cleans Contaminated Groundwater

After more than two years of design, assembly and testing, a mobile unit that cleans contaminated groundwater onsite is ready for use.

The Mobile Oxidation Pilot Plant (MOPP) is housed in a converted moving van trailer that contains special equipment to clean contaminated water as it is pumped through the system. One of the advanced cleaning processes uses ozone and ultraviolet light to thoroughly and economically destroy virtually any organic contaminant.

MOPP was successful in tests for cleaning water contaminated by trichlorethylene, an industrial solvent and a common groundwater pollutant. Aquatic chemist Gary Peyton of IWS hopes to use MOPP to clean up contaminated Illinois sites, including those on U.S. EPA's Superfund list.

Assistant Chief of Water Survey Retires

Richard J. Schicht, Assistant Chief of the Water Survey, retired on June 30 after 32 years of service.

As an engineer in the Survey's Hydrology Section, Schicht investigated groundwater recharge and aquifer yields and collected data on groundwater levels and use before being appointed Section head in 1977. In addition to his groundwater work, he supervised research on river hydraulics, sedimentation, urban hydrology, aquifer and well-field yields and watershed management.

In 1980 Schicht was named Assistant Chief and was responsible for coordinating the work of the Water Quality, Groundwater and Surface Water Sections.

CENTERING ON WASTE

Governor's Innovative Hazardous Waste Reduction Awards

The Hazardous Waste Research and Information Center (HWRIC) is accepting applications for the fourth annual Governor's awards for waste reduction. These are presented to companies, educational institutions, communities and public organizations that have made significant strides toward reducing hazardous wastes in Illinois. The deadline for applications is December 29, 1989.

For more information or to apply, contact Alisa Wickliff at 217/244-8905

Dr. David Rausch of Illinois Benedictine College instructs, using apparatus which allows the lab to reduce chemical use by as much as 95 percent. (Courtesy: HWRIC)

Asbestos Dust, Organic Solvents Focus of New Publications

Two new HWRIC publications are aimed at reducing hazardous wastes in automotive shops and metal-cleaning operations.

Asbestos is a major component of brake pads and accounts for 50 percent of their composition. New regulations will restrict or prohibit the use of asbestos in brake assemblies, but millions of cars with asbestos brake pads will remain on the roads. Automotive repair workers will continue to be exposed to asbestos dust when repairing brakes. *Controlling Asbestos in Automotive Shops* describes a special vacuum assembly unit (recommended by the National Institute for Occupational Health) that limits exposure to asbestos dust.

Metal cleaning with hazardous organic solvents is a common practice in many small and medium-sized businesses. *Alternatives to Organic Solvents in Metal Cleaning Operations* recommends less hazardous alternatives to organic solvents. Manufacturers of alternative cleaning compounds, solvent recyclers, waste haulers and disposers and other sources of information are listed.

To order either publication, call HWRIC at 217/333-8940.

Matching Funds for Waste Reduction

The Hazardous Waste Research and Information Center is accepting applications for its Recycling and Reduction Techniques (RRT) matching funds program in an ongoing grant review process.

The RRT program provides a total of $100,000 annually for the development of practical waste reduction techniques in industry. Individual awards can be as high as $50,000 and must be matched equally by the receiving company or organization. Examples of eligible projects include: plant waste audits; process modifications to eliminate use of toxic chemicals; testing equipment to reduce, detoxify or recyle a waste stream; marketing studies on recycling of a waste product.

To apply, call Sam Mehta at 217/244-8900.

GEOGRAMS

Oil Recovery

The Illinois Geological Survey (IGS) has received an award of $750,000 from the U.S. Department of Energy to develop economically viable strategies for increasing recovery of known oil from Illinois reservoirs. The grant, matched by the State of Illinois, covers the first 12 months of a four-year program.

"It is our belief that with both state and federal support and with the counsel of industry, the IGS is in a position to help increase Illinois' oil and gas production," according to Dr. Morris Leighton, IGS Chief. Leighton went on to explain that the Survey will initially focus on improving hydrocarbon recovery from existing reservoirs. Other Survey efforts will be targeted at locating new oil fields in subtle traps and in deeper plays in the Illinois Basin.

The project will serve as a model for mature oil-producing areas like Illinois, which produces 24 million barrels of oil per year.

Don Oltz of IGS demonstrates a core test system to improve oil well completion technology. (Courtesy: IGS)

Aboard the R/V Neptune, a 67-foot-research vessel, Michael J. Chrzastowski of IGS assists U.S. Geological Survey colleagues with bottom sampling of Lake Michigan.(Courtesy: IGS)

Beneath the Surface

To focus research efforts on groundwater, the IGS recently formed a Hydrogeology Research Laboratory. Its emphasis will be on the movement of fluids and chemicals in shales and glacial tills of very low permeability.

The Survey has also established a Quaternary Framework Studies Section to study the three-dimensional structure of glacial deposits and other surficial materials that overlie the state's bedrock. An understanding of the processes that resulted in these deposits is essential to wise economic development.

Scanning Lake Michigan's Shoreline

With a grant and cooperation from the U.S. Geological Survey, the Illinois Geological Survey has completed a sidescan sonar survey along the entire Chicago lakefront, complementing a 1987 survey. These surveys are used to document the nature of the damaged shoreline protection structures and the processes responsible for that damage.

The recent history of the Illinois shore and an inventory of properties along the shore are also being documented by IGS in a series of aerial photographs, digitized maps and a revised coastal atlas. The lake-level record is being extended back in geologic time. The Survey is analyzing samples taken by hand augering, digging soil pits and vibracoring in old beach ridges and in alluvial terraces in stream valleys tributary to the lake.

Michael J. Chrzastowski of IGS interprets sidescan sonar records of underwater contitions of shore structures along Chicago's shore front. (Courtesy: IGS)

Mapping For Landfills

Using modeling studies and mapping, the Geological Survey has quantitatively ranked the potential of various hydrogeological scenarios for groundwater contamination by leachates from land burial of municipal waste. These rankings can be used for preliminary feasibility assessments of site suitability for municipal landfills. The research also evaluated the appropriateness of a compliance distance of 100 feet surrounding a landfill as a limit for maximum leachate migration during a 100-year period. This distance is included in regulations proposed by the Illinois Pollution Control Board for solid non-hazardous waste disposal facilities.

Results indicate that this distance will place limits on the types of areas where landfills can be located. However regional scenarios allowing even shorter migration distances are found over 50 percent of the state. A less stringent compliance distance of 150 to 500 feet would add another five percent of the state to the favorable area.

The proposed regulations for non-hazardous waste landfills will require groundwater monitoring at or within the containment zone. An advantage to the shorter compliance distance (100 feet or less) would be the location of monitoring wells closer to the potential source of contamination. This would increase the likelihood of detecting contamination should it occur during a 100-year post-closure period. This would also decrease the potential volume of groundwater which could be contaminated before detection.

Another proposed regulation would require permit applicants to demonstrate that potential contaminants from proposed waste cells would be unlikely to migrate past the compliance distance during the 100-year post-closure period. Modeling to demonstrate compliance with the shorter distance will help avoid locating landfills in certain unfavorable hydrogeological environments. One such area would be over a low-yield aquifer, where some migration may be possible.

TRANSITIONS

New Board Members Named

Charles Marshall

Janice D. Florin

David E. Connor

Michael B. Witte

"When busy, successful people are willing to devote their time and talent to an organization, they believe in it and its purpose," said Society Board Chairman Gaylord Donnelley in welcoming four new Board members.

An Illinois native, Charles Marshall returned to his home state (residing in Chicago) as the retired Vice Chairman of the Board of AT&T based in New Jersey. The Greenville native earned an engineering degree from the University of Illinois in 1953 and went to work for Illinois Bell in Peoria. He was named President of Texas Operations for Southwestern Bell in 1975, Vice President and Treasurer of AT&T in New York City in 1976 and President and CEO of Illinois Bell in 1977. Back east again in 1981, Marshall was named Vice Chairman of the Board of AT&T in 1986. He is on the Board of several major corporations and also serves as President of the University of Illinois Foundation and Trustee of the University of Chicago.

Janice D. Florin is Manager of Environmental Affairs and Safety for Amoco Chemical Company in Chicago. She began her career at Amoco Corporation nine years ago. As a member of the Company's Management Committee, Florin has responsibility for corporate environmental, industrial hygiene and safety programs. A native of New York, she has a B.S. in Biology from Simmons College in Boston, an M.S in Environmental Science from Drexel University in Philadelphia and did post-graduate work at the University of London, School of Occupational Hygiene and Tropical Medicine. Florin serves on the Board of Directors of CIIT (Chemical Industry Institute of Toxicology) and is a member of the Chemical Manufacturers Association's Health & Safety Committee.

Before David E. Connor established David E. Connor and Associates financial advisers in 1985, he had been President and CEO of the Commercial National Bank of Peoria since 1967. Except for three periods of time - his earliest years, service as a Navy officer in World War II and earning his B.A. at Yale University - Connor has lived his life in and devoted his talents to Peoria, Illinois. The list of civic and community organizations to which he has given time is extensive and includes the Lakeview Museum, Peoria Development Corporation, Y.M.C.A., Tri-County Tomorrow and Bradley University Board of Trustees.

Michael B. Witte joined R. R. Donnelley and Sons Company in Chicago as Director of the Business Services Division in 1986. Prior to that time, Witte served as Director of the Illinois Department of Energy and Natural Resources from 1981 until 1983 and Director of the Illinois Department of Conservation from 1984 until he was chosen for his present position. Witte is on the Board of the Illinois State Museum, the Illinois Chapter of the Nature Conservancy, the Open Lands Project, the Committee on the Middlefork and the Coal Research Board.

Leo R. Whalen: Society Loses a Long-Time Advocate

The Best Little Duck Ranch in Hanover is the title of a feature story in the Spring/Summer 1989 issue of **The Nature of Illinois**. Developing the story of Whistling Wings in Hanover, Illinois, and of its founder and owner, Leo R. Whalen, was the Society's salute to a long-time Board member and devoted conservationist. Leo R. Whalen died in July. His mallard duck ranch and his family are a living tribute to a man who cared. He will be remembered. He will be missed.

Mallard duck drawing by John Sherrod, artist, Illinois Natural History Survey

FAULT FINDING

by Tara McClellan

"Earthquakes in Illinois? Oh, come on. You've got to be kidding!"

That might be the reaction of many in Illinois, but not the people of Richland County after the earth shook near Claremont on June 10, 1987. That earthquake was strong enough to be felt in Champaign-Urbana, 100 miles to the north. But Althea Williams, editor of the *Daily Mail* in Olney, Illinois, 12 miles west of Claremont, says the quake caused little damage. "The chimney on Wayne Zirkle's funeral home here in Olney fell down, but that's about the only significant damage I can remember. Certainly no one was injured," she said.

Earthquakes occur when rocks can no longer withstand the strain imposed on them by forces in the earth's crust. Like breaking a stick over your knee, the rocks finally give way along a fault plane and slip past one another. A small earthquake may mean that the rock masses have slipped only a few inches; larger quakes may involve displacements of several feet in just a few seconds time. Faults mark the position where these breaks have occurred.

Other subsurface hazards include sink holes, old mines and faults according to Illinois Geological Survey (IGS) Geologist John Nelson. Sink holes occur more often in southern and western Illinois where underground cavities in limestone bedrock cave in. A greater hazard is old coal mines which cave in or subside.

John Nelson has mapped numerous fault traces in southern Illinois in the last 10 years. Many of these are related to the Cottage Grove Fault System, a complex series of faults running east-west near Harrisburg and DuQuoin. According to Nelson, the Cottage Grove system is just one of several major fault systems that meet in southern Illinois, but all of them are inactive.

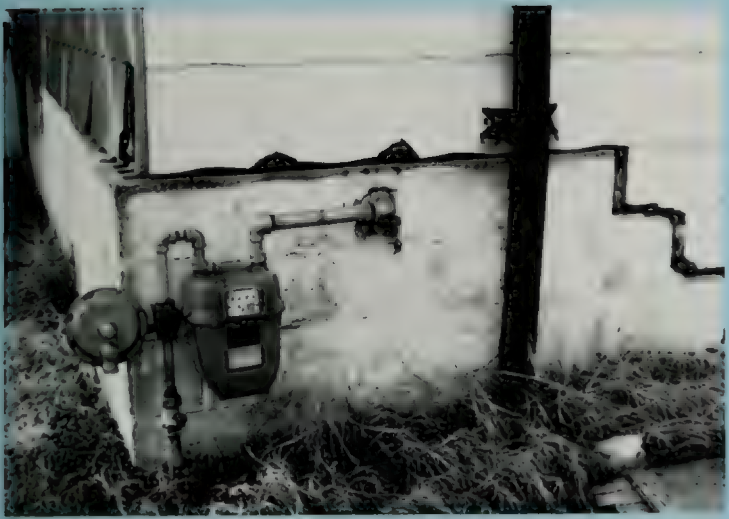
"The evidence in the rocks clearly shows that none of the mapped faults in Illinois have moved at all in the last 200,000 years," Nelson says. But, since small earthquakes occur at the rate of about 3 per year in Illinois, active faults must exist. According to Nelson, those faults are too small and buried too deep in the earth to detect.

Paul Heigold, lead goephysicist for the IGS notes that, within recorded history, there has never been an Illinois-epicentered earthquake with an intensity greater than VII on the Modified Mercalli scale which has values from I to XII. (The intensity scale is based on the damage and shaking caused by an earthquake). "Overall, Illinois is remarkably stable and earthquake free. There has never been an Illinois-based earthquake that caused serious damage to well-made structures. We are much more concerned about the New Madrid seismic zone just outside Illinois than we are about our own faults," he said.

New Madrid

Probably the most famous (or infamous) Midwestern fault is the New Madrid which caused three major earthquakes and hundreds of smaller ones between 1811 and 1812. The New Madrid starts at southern

Illinois Power Company nuclear plant at Clinton, Illinois



Mine subsidence damaged this home built over an old abandoned coal mine. Old room-and-pillar mines removed much more coal than today's regulated mine designs. (Courtesy: IGS)

Illinois' tip and extends through Arkansas. This is the "Bonnie and Clyde" of faults. Its 1811-1812 quakes destroyed a town and killed several people. Scientists believe it will strike again, but don't know when.

Most geologists say future earthquakes epicentered in Illinois don't pose that great a risk to the state. But another New Madrid event does. That's the greatest seismic risk facing Illinois, Heigold says. Since southern Illinois is close to Missouri (the epicenter of a New Madrid event), the intensity of such an event could be at high enough levels to cause "destructive" to "very disastrous" damage in southern Illinois.

According to a scheme developed in 1969 for assessing seismic risk based on historical earthquakes and known zones of weakness (faults) in the earth's crust, Illinois is divided into three risk zones where major, moderate and minor damage from future earthquakes can be expected. The zone where major damage is likely is in southern Illinois. Only minor damage is expected in most of northern Illinois.

Heigold says areas along the Mississippi River have greater risks of quake damage. During quakes the loose surface material there, such as sand and gravel, can become like quicksand and cause buildings to fall. Heigold says there is evidence that this process, called liquefaction, has occurred in southern Illinois.

Industrial Hazards

While earthquakes pose a risk to all structures, they present special hazards to industries using dangerous substances or fine-tuned instruments. These industries usually try to construct their facilities to withstand the most damaging seismic event expected in that area. Facilities like this include nuclear power plants, utility companies, hospitals, waste sites, gas companies, pipelines, dams and bridges.

Nuclear power plants have always paid special attention to seismic risk. The Nuclear Regulatory Commission funded work by the U.S. Geological Survey to establish a national seismic network to provide information about seismic risks. It also funded a ten-year study of the New Madrid seismic zone to understand how another event there would affect nuclear power plants.

Using their knowledge of the state's geology, IGS scientists help industries find geologically appropriate sites for new plants. Paul DuMontelle, assistant branch chief of the Survey's Environmental Geology and Geochemistry Branch, says IGS prepares reports for industry that review the characteristics of a potential site that must be considered in engineering a plant, including the presence of underground mines, the strength of the surface materials, the availability of groundwater and the seismic risk. DuMontelle says reports have been prepared for a variety of firms: the Diamond Star Motors plant at Bloomington-Normal, Fermi National Accelerator Laboratory, Argonne National Laboratory, Genstar (a Kankakee waste incineration plant, Hyster (a Danville forklift manufacturer) and Illinois Valley Community College among others.

Richard C. Berg, Geologist and Head of IGS's Groundwater Protection Section, reports that the Survey also produced a handbook for siting waste facilities. It has a checklist of about 40 various geological and hydrological factors, including seismic risk, to consider when siting waste facilities.

The Survey has access to a computer mapping system which can help in these efforts. The Geographic Information System (GIS) creates multi-dimensional maps of an area's natural resources, including aquifers, woodlands, streams, faults and potential geological hazards.

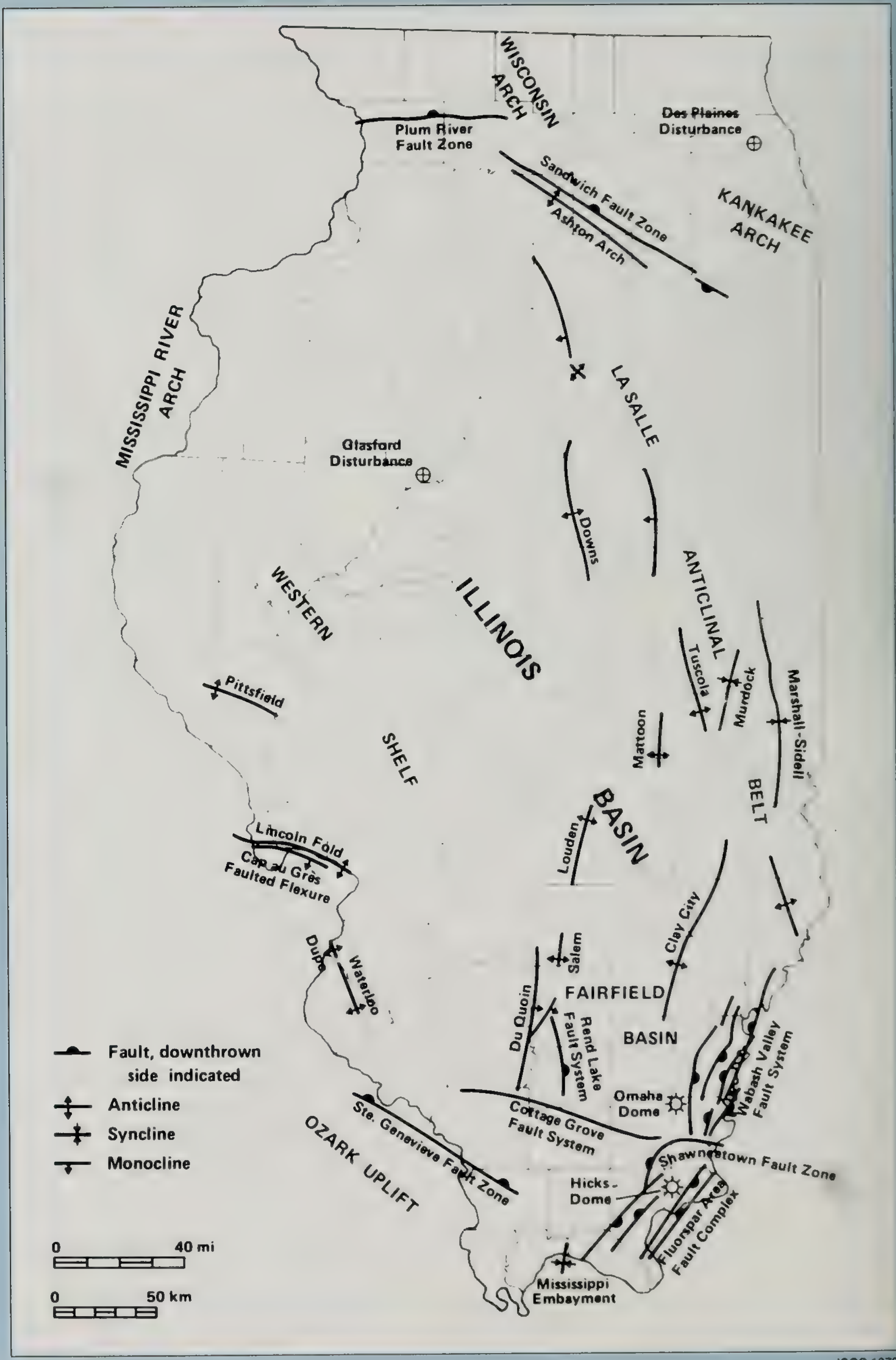
According to William J. Hall, Head of the Civil Engineering Department at the University of Illinois, industry is becoming more aware of seismic hazards. While nuclear power plants and waste facilities are usually mandated by state and federal laws to consider a potential site's seismic history, other industries are beginning to follow suit. Companies that haven't done so before are now starting to look at the "seismic fragility" of their existing and future facilities.

"The first worry is people," Hall states. "The second is to minimize the financial loss and service to people (that a quake might cause)."

Once an area's seismic risk in determined, the facility will have to uses materials and construction methods that enable it to withstand the area's worst potential quake. If the building uses federal funds, it has to meet a national building code which has quake provi sions. Otherwise it may have to meet a local city code. Some of these have quake provisions, Hall says, but they are not always enforced.

"The general policy in the quake field regarding sites like liguid natural gas companies, pipelines, and the like is don't build anything over a fault if you can help it," he explains.

Heigold says siting a building usually comes down to an economic factor. "Almost any geologic factor can be engineered away with enough money." If permitted by law, an industry may still site in a moderate or high seismic risk area, but it will pay dearly to "quake-proof" the facility. ■


WISCONSIN ARCH
Plum River Fault Zone
Des Plaines Disturbance
Sandwich Fault Zone
Ashton Arch
KANKAKEE ARCH
MISSISSIPPI RIVER ARCH
LA SALLE
Glasford Disturbance
Downs
ANTICLINAL
WESTERN
ILLINOIS
Tuscola
Murdock
Marshall-Sidell
Pittsfield
SHELF
Mattoon
BASIN
BELT
Louden
Lincoln Fold
Cap au Grès Faulted Flexure
Clay City
Dupo
Waterloo
Salem
FAIRFIELD
Du Quoin
Rend Lake Fault System
BASIN
Wabash Valley Fault System
Omaha Dome
Fault, downthrown side indicated
Anticline
Syncline
Monocline
Cottage Grove Fault System
Ste. Genevieve Fault Zone
OZARK UPLIFT
Shawneetown Fault Zone
Hicks Dome
Fluorspar Area Fault Complex
Mississippi Embayment
0 40 mi
0 50 km

ISGS 1979

Major geologic structures of Illinois, compiled by Janis D. Treworgy, Dec. 1979.

WHERE WATER IS GOLD

By Thomas E. Rice

Center pivot irrigation system watering corn

"There is no substitute for good soil," says farmer Scott Talbott on a steamy July morning after turning on an irrigation system that waters his tomatoes, peppers and sweet corn.

The soil on Talbott's land at the border of Mason and Tazewell Counties in west-central Illinois is not much better than a sand dune. The sandy soil cannot adequately capture the moisture provided by rainfall, so farmers like Talbott must tap groundwater and pump it through irrigation systems to supplement what nature gives above ground.

Growers in Illinois who use irrigation on their sandy soils have increased crop yields significantly. Their success, as well as the use of irrigation to combat drought on all soil types in other regions of the state, has swelled the number of irrigated acres in Illinois. An estimated 200,000 acres are now being irrigated in the state, about 20 times more than in 1950.

"Irrigation in Illinois is an anomaly," says hydrologist Jean Bowman of the Illinois Water Survey. "Most farmers in the state will probably tell you the soil is everything. If you talk to irrigators in Mason County they'll probably say their most important resource is the water."

Bowman and University of Illinois agronomist Bill Simmons are studying irrigation water use in Illinois in response to concerns about possible depletion of groundwater reserves because of increased irrigation. They are assessing irrigation patterns and the potential for conserving irrigation water without significantly reducing crop yields.

"Our preliminary findings indicate that irrigation has not permanently depleted groundwater resources anywhere in Illinois," Bowman says. "In fact, depletion would be highly unlikely in most of the irrigated regions of the state. But irrigation does require a substantial amount of groundwater, and it can cause well-interference problems.

"For these reasons, there is a need to quantify irrigation water use, to learn its effect on groundwater levels, and to make it as efficient as possible, so that groundwater can be conserved, as well as farmers' time and money."

Soaking the Soil

Mason County and adjoining southern Tazewell County are the chief areas of irrigation in Illinois, with more than 800 irrigation systems in use in the area and about 100,000 acres irrigated, or half the state total.

Groundwater resources in the Havana Lowlands in Mason and Tazewell Counties are among the most plentiful in Illinois. Groundwater is stored and transported underground in sand-and-gravel deposits that were either washed into ancient river valleys during the Ice

Age or were the outwash of the present day Illinois River. These deposits comprise the huge Mahomet-Teays Aquifer, which covers about 720 square miles in the two counties. These groundwater resources are recharged by precipitation that percolates down from the soil surface.

Leo Pfeiffer, who farms 3,500 acres in Mason County with sons Dean and Darrell, is said to have been the first Mason County irrigator. "In the fall of the drought year 1953 I was picking corn," Pfeiffer remembers, "and I knew I wanted enough moisture for the next year's crop, so I thought I'd try something different." He began irrigating corn the next growing season.

"Water is our gold," says Manito grower J. D. Proehl, whose family has been farming in the area since 1891. His father Walter also began irrigating crops in the early 1950s.

Scott Talbott and his father Gnile head a large family operation that includes almost 3,000 acres of farmland, irrigation system sales, and produce stands. Scott farms 700 acres and helps manage the rest of the family acreage.

"The advent of irrigation meant making the same acreage twice as productive," Scott says. "It changed a lot of farm situations from minimally productive to competitive with those farms with heavier soils."

The primary system used for irrigation in the Mason-Tazewell area is the center-pivot system, an electronically or diesel-powered watering system that moves slowly around a stationary center pivot in a circular pattern while watering crops with groundwater pumped from a nearby well. These systems allow irrigators to grow a variety of crops that thrive on the controlled amounts of water that irrigation provides.

Cornucopia of Crops

Ed Whitaker, Mason County Farm Bureau President, proudly wears a cap stamped with the slogan, "The Imperial Valley of the Midwest," after the California desert valley made lush by irrigation and noted for nationwide distribution of its fruits and vegtables. The slogan is appropriate. Besides field corn and soybeans, farmers in Mason and southern Tazewell Counties grow a variety of specialty crops, including cantaloupes, watermelons, potatoes, cucumbers, popcorn, sweet corn, green beans, peas, cabbage, tomatoes, peppers, and pumpkins.

"In many parts of the state farmers are very unwilling to try anything new," Whitaker says. "I would say it's just about the reverse here. Farmers here don't just jump into anything, but if they think there's a chance to make a profit, they'll try it. We're a completely different breed of cat here."

Talbott family cantaloupes ready to go to family's produce stands and local grocery stores.

The controlled growing conditions attract major food companies and wholesalers. Many of the specialty crops are contracted to Del Monte, Heinz, Stokely, Dean Foods, and other food companies, or to brokers who supply harvested crops to these companies and to food store chains. Some produce goes directly to farmers' markets.

Northeast Illinois Irrigation

Kankakee and Iroquois Counties have the state's second highest concentration of irrigated farmland and a long history of irrigation dating back to at least 1926. Irrigators in the area grow many of the same specialty crops as the Mason-Tazewell farmers.

Water Survey hydrologist Stu Cravens has worked closely with

Kankakee-Iroquois irrigators. He is studying the area's irrigation water use to aid in planning and development of groundwater resources in the region. "I think the farmers feel that the water is their lifeblood," Cravens says, "and that the only reason they can irrigate at all is the availability of groundwater."

Kankakee County Farm Bureau President Bob Dyer says irrigation is a management decision that takes one of the variables out of production, that of having enough water. "The return is also greater," he says. "I would say the value of irrigated crops, although there are far fewer acres of them, would approach the value of non-irrigated crops in this county, probably 60 to 70 percent of the value of non-irrigated corn and soybeans."

Kankakee-Iroquois irrigators drill from 60 to 400 feet deep to tap their main groundwater reserves, stored in the crevices and fractures of bedrock. These reserves are recharged primarily from vertical leakage of groundwater, that is, precipitation that has filtered down through sand, silt, and clay deposits above the bedrock.

A variety of irrigation systems that are either fixed in a location or are moved by motors or water pressure are used in Kankakee and Iroquois Counties. Sod, which is grown in the area primarily for the Chicago and suburban commercial and residential market, uses several different systems. A fixed-pipe system with outlets that water between rows is common for irrigating flowers.

Strawflower in Schaafsma/Soucie field

Mason County pickers

Flowers Galore

Elwood and Ken Miedema grow 100 acres of flowers in southern Kankakee County - nothing but gladiolus, 40 varieties - in addition to 1,500 acres of corn and soybeans. Large orders of flowers are contracted to florists and flower wholesalers in Chicago, Milwaukee and cities in Ohio.

The Miedemas depend on irrigation for watering all their flowers. "We couldn't do without it and still grow our glads," says Elwood. "The heat of 95-degree summer days can burn them up." The Miedemas and many other farmers in the area around Wichert are among the many descendants of Dutch settlers who came to the area from South Holland, Illinois. Craig Schaafsma, whose great-grandfather was a Dutch grower in the area, irrigates 30 varieties of flowers on 40 acres. It is his only crop. Schaafsma follows his father and grandfather in the flower-growing business.

Schaafsma's partner, Bob Soucie, is one of many southern Kankakee-northern Iroquois County residents descended from French-Canadian settlers. "Before we became partners in the business, Bob was a forest ranger in South Dakota and I worked in a factory in Kankakee," Schaafsma explains. "I was going to farmers' markets on the side and growing a few things while I was working in the factory. Every year the flower business was getting a little better. I told Bob about it, and here we are."

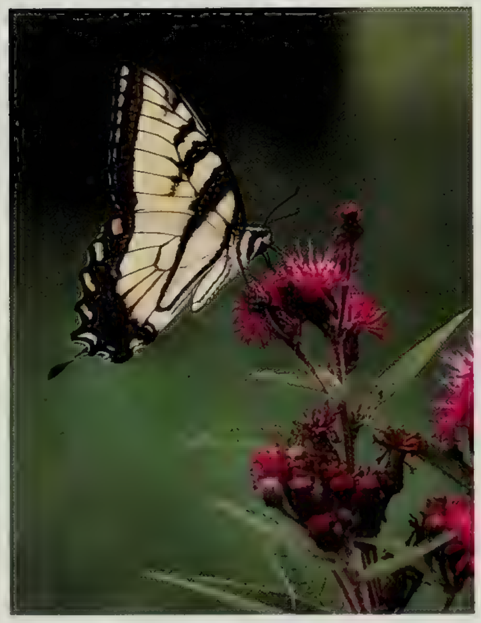
Almost all of the Schaafsma/Soucie flowers - from asters to zinnias - go to farmers' markets in northside neighborhoods in Chicago.

Flowers for the dining room table, pickles and catsup for hamburgers, popcorn while watching television, watermelon for a picnic, pumpkins for jack-o-lanterns, or sod for the front yard - these are just a few of the products that come from tapping our natural groundwater resources for irrigation. It's nature below helping nature above. ■

A Smaller World

by Michael Jeffords

Adult acorn weevil



Male tiger swallowtail feeding at ironweed

The question often arises whether insects, rather than their relatively frail human counterparts, will ultimately inherit the Earth - and not only among science fiction writers. After all, insects have been around for many millions of years longer than humans, and certain species like the cockroach have changed very little during that time. Obviously, insects have stumbled upon a very successful design and show no inclination to decline in the near future. If we examine the facts closely, we must conclude, "No, the insects will not inherit the Earth, they already have!" Approximately 1.4 million species of organisms that have been described by scientists currently inhabit the Earth. Approximately 65 percent of those, nearly 900,000 species, are insects and their close relatives. For every human being on Earth, there may be 200 million insects! In Illinois alone over 25,000 species of insects have been found, ranging in size from a six-inch walking stick from southern Illinois to tiny beetles that will fit on the head of a pin. Although most people are difficult to convince, the vast majority of insects do not inhabit our homes, eat our crops, bite us, or otherwise cause distress. Rather, they are essential parts of the natural world - as pollinators, as food for other animals, as food producers and as fascinating creatures that deserve our attention. Take a close look at a few of these remarkable creatures that share our state. ■

Fall aggregration of ladybird beetles preparing to overwinter

White-marked tussock moth on fern frond

NATURE AMONG THE RUINS

by Tara McClellan

Redwing blackbirds nest in cattails

"It's been over a century since the Army Corps of Engineers and George Pullman decided to turn the sprawling marshes between Lake Calumet and Lake Michigan into an industrial center...They took an area about four miles square and filled it with dirt, with clay dredged from Lake Calumet, with phenols, oils, ferrous sulfide, and thousands of other substances you not only never heard of, you never want to." (Paretsky, *Blood Shot,* Dell Publishing, 1988.)

The only thing Sara Paretsky forgot to mention in this excerpt from her mystery, set in the polluted Lake Calumet area, is the incredible nature that still survives there.

Chicago's southeast side has been called a "chemical quagmire" and a "toxic trap." Those are some of its nicer names. Yet its patchy marshes are deemed ecological paradises.

Lake Calumet's approximately 60 square mile area has nearly 100 abandoned or barely operating industrial plants, about 50 open or closed waste disposal facilities, toxic waste dumps, sludge drying beds, dumps, a hazardous waste incinerator, landfills, neighborhoods, major highways, and yes, wetlands with wonderful wildlife.

The area is a living battlefield. It is checkerboarded with squares of nature's attempts to beat the industrial wasteland engulfing it. Many question why no victor has arisen yet. The real question is who the victor will be.

One of the many groups tackling that question is the Hazardous Waste Research and Information Center. "We're trying to address the full range of environmental problems in the southeast Chicago area," says Gary Miller, Assistant Director and Research Frogram Manager for the Center. The Center studied the area's development and pollution history, and the contamination of its air, surface, and Lake Calumet's sediment.

The Center is building an inventory of possible sources of contamination and chemicals used there. It is also trying to monitor the area to see what the sources are and what risks people are exposed to.

Fort Calumet

"The Lake Calumet area was originally a low, swampy area...kind of a no-man's

Scrap metal yard along shoreline

land" according to Craig Colten, Associate Curator of Geography for the Illinois State Museum, who has studied the area's history. "In the 1860s some local boosters felt it would be an ideal site for a new port for Chicago...the Chicago River was getting too congested. So the developers thought they could shift the industrial heart of Chicago and develop large-scale port facilities there."

Developers believed the area had several advantages: water and rail access, proximity to Chicago, cheap land, low taxes, low construction costs, and marshlands which could be used for industrial growth and waste disposal.

"The developers began lobbying Congress and got money for the U.S. Army Corps of Engineers to make improvements at the mouth of the Calumet River to enable larger ships to enter," Colten explains.

In the 1870s industry began moving in. Iron and steel manufacturers were first and remained foremost. Their support industries followed. Others included grain and wood handling facilities, the Pullman railroad car company, chemical companies, a paint manufacturing company, flour mills, beverage firms and agricultural producers.

A Century of Waste

With industry came waste. Industry's disposal methods evolved over the years, shifting slowly from an emphasis on water to land disposal. The disposal methods mirrored public perception regarding the value of wetlands and waterways, and the origin of disease.

"Originally (before 1890) wetlands were associated with health dangers like mosquitoes and disease-carrying fumes. So people put waste in them to reclaim them," Colten says.

In the 1890s industry started dumping toxic wastes in streams in the belief that this diluted the wastes and carried them far from urban areas. "People thought the wastes killed bad germs in the waterways," Colten adds. (There was one early dissenter. In the 1890s the Army Engineers voiced their concern about this practice.) In 1922 the Calumet River's flow was reversed so waste-carrying streams would not taint Lake Michigan, but drain into rural Illinois.

By the 1940s Congress had become concerned with the obvious damage to America's waterways and enacted legislation to control water pollution. Industry slowly started dumping wastes onto land instead of into water. Landfills became popular and the City of Chicago opened a major one on the lake's northern end.

Tires and debris along shoreline

The environmentally conscious sixties ushered in new concern for clean land, tougher federal legislation and the creation of the United States Environmental Protection Agency. With new restrictions on water dumping, manufacturers once again focused on land dumping.

After 110 years of practically uncontrolled dumping it has become difficult to determine how much of what substances are where. Industry did not keep effective records of its waste disposal until the late seventies.

A Toxic Trap

Colten says land wastes included toxic metals like cadmium, chromium, acids, and slag from the steel mills. Water wastes included acids, oils from refineries, phenols from steel mills, ammonia, sulphur, cyanides, and arsenic.

A 1986 Illinois Environmental Protection Agency study of the area found 20 chemicals polluting the land, 13 polluting the water, and 28 polluting the air. Arsenic, cadmium, iron, lead, benzene, xylenes, and pyridine dot the landscape. Ammonia, lead, cyanide, PCBs, chlordanes, and DDT swirl in the water. Ozone, lead, arsenic, acetone, hexane, naphtha, methanol, and phenol pepper the air.

Doctor Philippe Ross, Associate Professional Scientist with the Illinois Natural History Survey (INHS), studied the lake sediment's toxicity for the Center. He found "really high concentrations of heavy metals...and lots of polynuclear aromatic hydrocarbons (PAHs) in the sediment." Ross says these substances are very hazardous and many are carcinogens.

Ah, Wilderness

Despite this, small pockets of nature thrive. "We went up not expecting to find a single twig" says Pamela Tazik, INHS Associate Research Biologist, who studied the wetlands' aquatic plants. "But we found beautiful arrowhead, cattail and pond weeds. We were shocked."

William E. Southern, Professor of Biological Sciences at Northern Illinois University, discovered similar results when he studied the wildlife in 1982.

"If you base the quality (of the wetlands) on the plant and wildlife there, their quality was surprisingly high. But if you look at it aesthetically and smell it, you think 'what a dump.' You don't expect anything to be there, but the species just kept rolling in, and we were overwhelmed by the wealth."

Fifteen of the 175 bird species there are listed as threatened or endangered in Illinois including the double-crested cormorant, great egret, Wilson's phalarope, short-eared owl, marsh hawk, and osprey. The area also has a herring gull rookery and ring-billed gull colony which are rare in Illinois, and it is a popular resting place for migratory waterfowl.

Southern found a much more diverse fish population than expected with a total of 27 species, including 10 game fish species. While none were threatened or endangered he concluded that "fish fauna was of good quality, which blew our minds." (A Center report says historical records show that the fish community's diversity has declined over the years.)

How do the flora and fauna survive in this toxic trap? No one is sure. The area still offers good, though sparse, habitats. And Tazik says aquatic plants have a kind of defense mechanism which "stores certain levels of some toxic substances in their system and allows them to carry out life processes."

"The big question is what's happening to them in the long term...they may be picking up pollutants," Southern says, verbalizing the Big Question.

An Abundance of Death

A 1988 Center environmental assessment report concluded that the aquatic ecosystem has probably been altered by toxic contaminants, and these contaminants may be entering the food chain and could endanger wildlife. It states "Chemical compounds common to industry in the Calumet region since the 1870s have concentrated in the sediments of the lake, and consequently, the potential for bioaccumulation in aquatic plants, invertebrates, fish, and perhaps waterfowl and humans is high."

There is a scary epilogue to the story. In July 1988 a scientist studying water runoff into the lake found "an abundance of death." Four dozen dead gulls and numerous dead fish surrounded the storm drain where Bill Fitzpatrick collected water samples. Fitzpatrick, an Associate Hydrologist with the Illinois Water Survey, says other agencies investigating the situation told him they found thousands of carcasses in the area's rookeries.

While there's "no definitive answer regarding the cause of the deaths" Fitzpatrick says it's possible that what killed the animals could have come from the storm drain emptying into the lake. He's seen "tremendous amounts of toxic metals" entering the lake at various times, and there are "dozens of pollution sources to Lake Calumet."

Yellow-headed blackbird along shoreline

"This means pollution is continuing there and needs to be controlled," Fitzpatrick says. He thinks it's endangering the wildlife and has the potential for contaminating Lake Michigan, the water supply for millions of Midwesterners. The Illinois Environmental Protection Agency is investigating the matter and has fined at least one polluter. The Center, Fitzpatrick, and most scientists who've studied there recommend further studies of the area's pollution and possible effects on flora, fauna and people.

Southeast Chicago is full of chemical ghosts in its land, air, and water. Some of these contaminants can remain hazardous for several decades. Disturbing the landscape will literally stir up long-buried pollutants.

The future is uncertain. A Center report says "Continued habitat degradation and contaminated food could affect the future status of (some of the area's endangered) birds."

Fitzpatrick echoes that concern: "The wetlands have been carved up in such small pieces, I'm not very optimistic regarding their long term survival."

But Chicago has ideas for Calumet. The Chicago Port Authority has plans to fill in most of the lake for an industrial park with recreational areas. It's uncertain when or if these plans will be implemented. The future of the area is a big, unanswered question...and Lake Calumet has lots of those. ■

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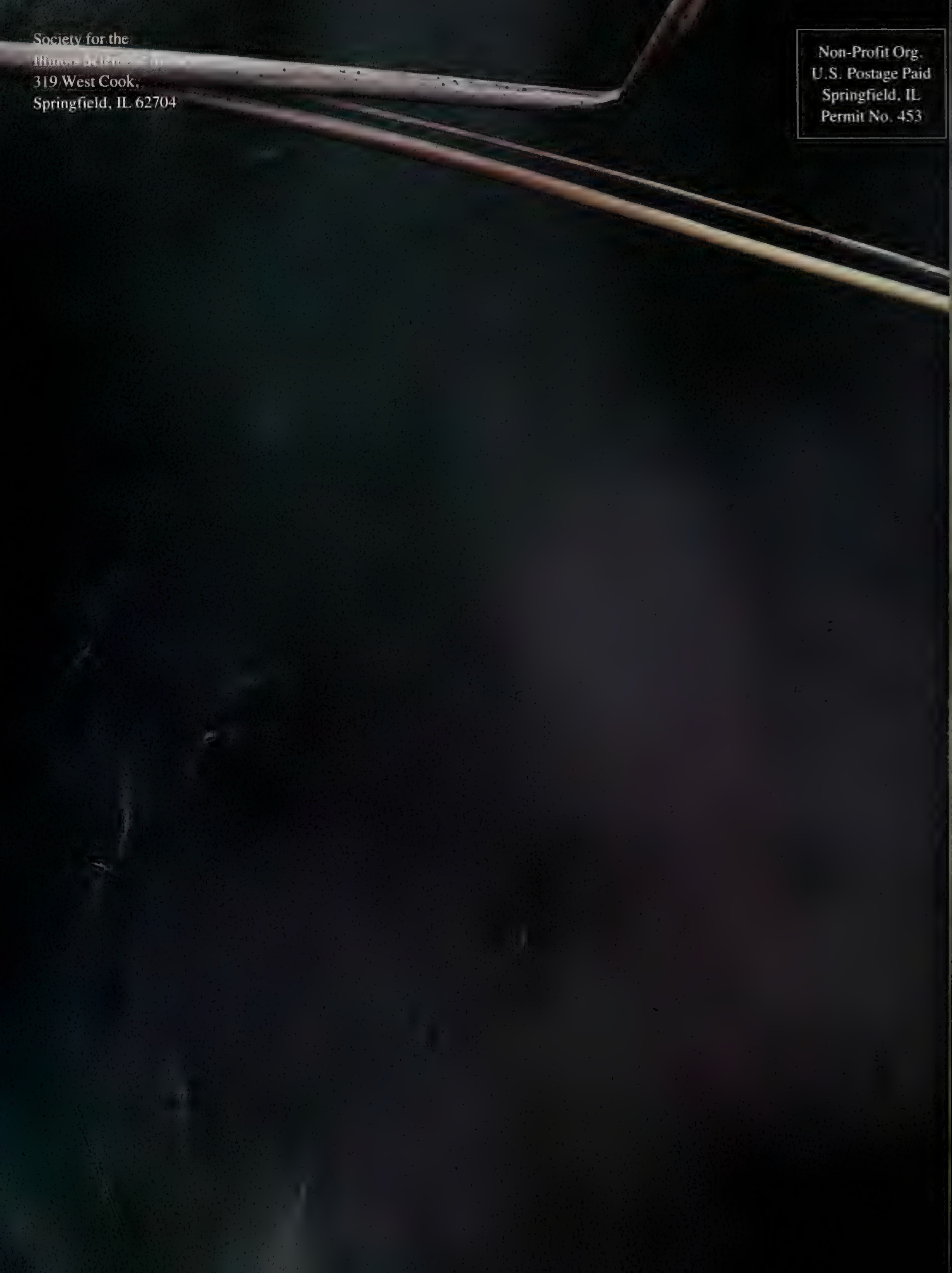

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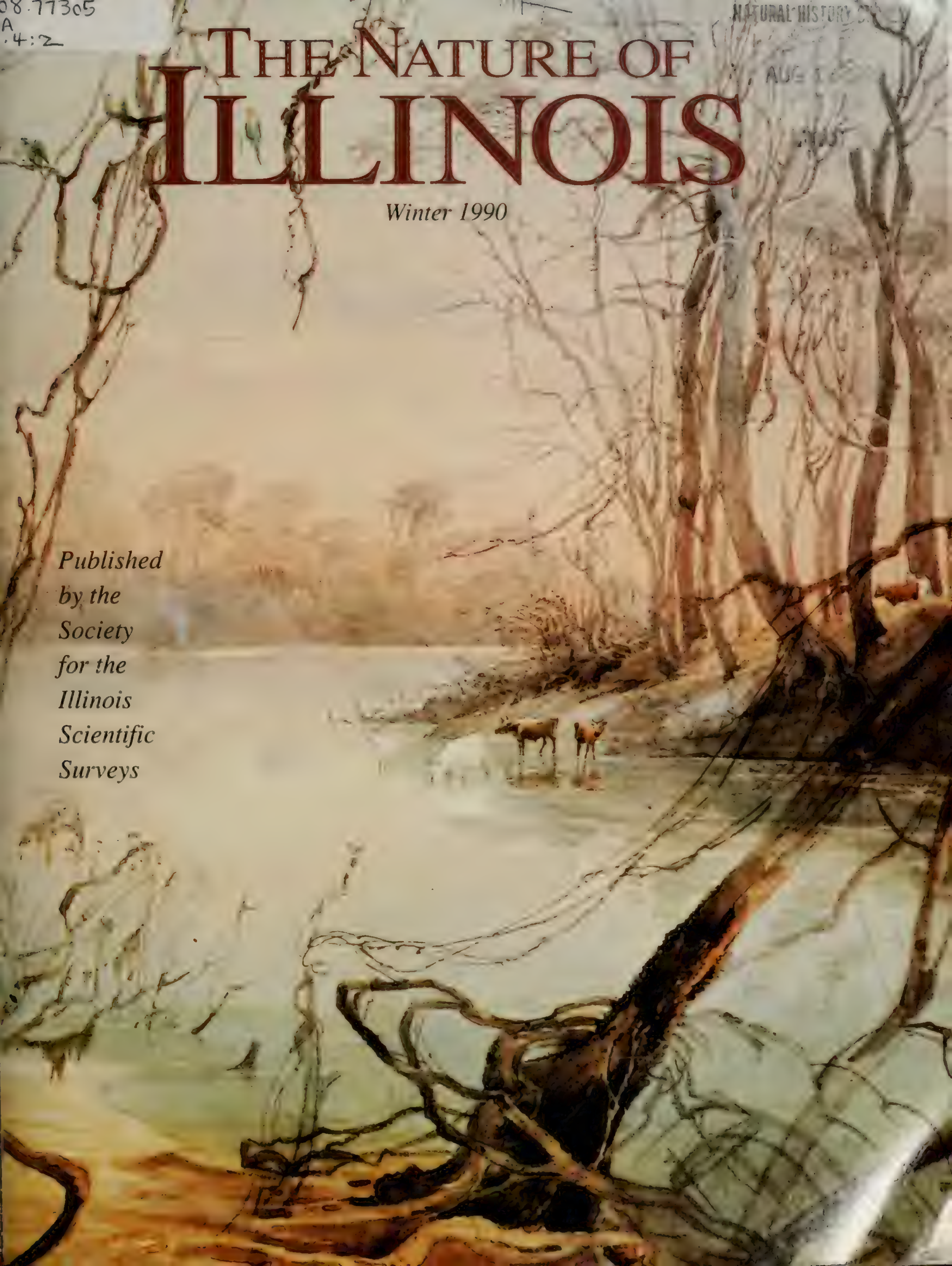
Winter 1990



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THE NATURE OF ILLINOIS

Winter 1990

The Society Page

The natural riches of Illinois have long been a magnet to immigrants from every part of the world, and many **utopian societies** found their Eden on the prairie. Three are profiled in this issue.

From the Pottawatomi Indians to the descendants of European settlers, the **Kankakee River** has been a haven and a way of life. Tom Rice of the Illinois Water Survey chronicles the river's rise and decline.

There's something in the air, and it can leave you breathless. Whether you have respiratory problems or healthy lungs, you should know more about **ozone.**

Our **Art of Nature** series focuses on **Karl Bodmer's Illinois.** "The man who stopped to paint America" did a beautiful job of illustrating nineteenth century Illinois.

This issue also features the first article in a new series on **the history of the Illinois Scientific Surveys. Amos Worthen**, a small town merchant with a passion for geology, conducted the first real geological survey of all 56,000 square miles of the Prairie State.

Old Iron, by Natural History Survey scientists Susan Post and Michael Jeffords, looks at the men who buy, restore and exhibit the old workhorses of Illinois farming - antique steam, tractor and gas engines.

I hope you will join me in becoming a member of the Society.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Confluence of the Fox River and the Wabash, watercolor on paper by Karl Bodmer. (Courtesy: Joslyn Art Museum, Omaha, Nebraska)

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Editorial Staff
Jane A. Bolin *Editor*
Jane Christman *Assistant to the Editor*
Michael Jeffords *Photographer*

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HEAVEN ON EARTH:

UTOPIANS ON THE PRAIRIE

by William Furry

UTOPIA: *(1) An imaginary island depicted by Sir Thomas More as enjoying a perfect social, legal and political system; b. Any imaginary, indefinitely-remote region, country or locality. (2) A place or condition ideally perfect in respect of politics, laws, customs and conditions. b. Any impossible ideal scheme, esp. for social improvement. From the* ***Oxford English Dictionary****.*

Paradise, to recoin an antique adage, is in the eyes of the beholder, and for some nineteenth century Illinois settlers, the wide-open prairie was, indeed, a paradise to behold. To a fifth generation tenant farmer newly immigrated to Illinois in the 1840s, the boundless, fertile and inexpensive prairie farmland open for settlement must have seemed paradisaical.

But to another group of settlers, the expansive prairie presented social, even theological possibilities. These settlers were the utopians - the men, women and children who gave up their homes, their families and often their lives to come to Illinois and build a new heaven on earth. To the utopians - the Mormons and the Icarians at Nauvoo and the Jannsonites of Bishop Hill - Illinois was a prophecy fulfilled, the proverbial land of milk and honey, a new Canaan for a chosen people.

Paradise on the River

Way down upon the Wabash, such
land was never known,
If Adam had passed over it the soil
he'd surely own.
He'd think it was the garden, he
played in when a boy,
And straight pronounce it Eden in
the state of El-A-Noy.

American folk song

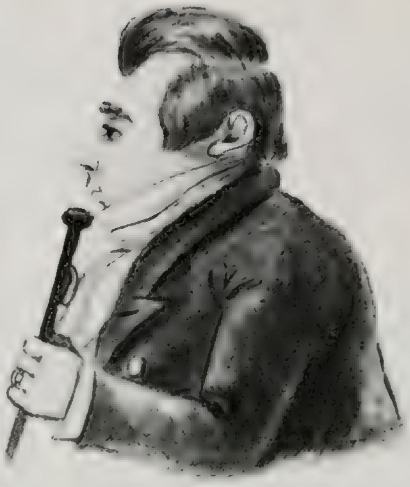
Rainbow over Bishop Hill

Illinois wasn't everyone's idea of paradise. The English novelist Charles Dickens, on his first visit to America in 1842, found the young state a land of "swamps, bushes and chirping bullfrogs." Even a prairie sunset had little to offer Dickens. Pausing outside of Levanon, Illinois, one spring evening, Dickens appraised the prairie thusly: "There it lay," he wrote, "a tranquil sea or lake without water...It was lonely and wild, oppressive in its barren monotony...It's not a scene to be forgotten, but it is scarcely one...to be remembered with much pleasure, or to covet the looking on again, in after-life."

In 1825, seventeen years before Dickens raised his indifferent eyebrows over the prairie, paradise already existed on the banks of the Wabash River. It was in that year that Robert Owen, the Scottish industrialist and philanthropist, established his own edenic experiment at New Harmony, Indiana. Contrary to the folk song quoted above, Owen's Eden got its start on the opposite bank of the Wabash, which may go a long way toward explaining why the New Harmony experiment winked out after only two years.

Although Owen's utopia - an economic community founded on his unconventional beliefs in universal suffrage and education, and better living and working environments for workers - did not last, its influence was extensive, especially in the fields of education and geology. Owen's son, David Dale Owen, was named the nation's first U.S. Geologist, and he established at New Harmony the country's first headquarters for the U.S. Geological Survey in 1839.

In 1842, 200 miles up the Mississippi River from the spot where Dickens was taking in the prairie sunset, Joseph Smith and his Church of Jesus Christ Latter Day Saints were building their "city on the hill" at Nauvoo (a Hebrew word roughly translating "beauty and repose").



Joseph Smith of Nauvoo (Courtesy: Illinois State Historical Library)

For the Mormons, a millenarian sect composed of reformed Methodists, Baptists, and members of unorthodox religions, Nauvoo would be their third attempt to build "God's City" on the frontier. The sect had settlements in Ohio and Missouri, but in 1839, after violence broke out between Mormons and "gentiles" in the Mormon settlement known as Far West, Missouri, Smith decided to pack up his disciples and move someplace else, either to Illinois or Iowa. First Smith had to get out of jail.

A Town Called Commerce

Meanwhile, the Mormons sans Smith had relocated to Quincy, Illinois, until a site for their new kingdom could be decided upon. When Smith arrived on the scene (he finally escaped from jail), he settled his flock in Hancock County on a peninsula jutting out into the Mississippi River near a town called Commerce, Illinois. Smith's recorded observations of the settlement site weren't all that descriptive of paradise. In fact, he sounds a bit Dickensian when he writes: "The place was literally a wilderness. The land was mostly covered with trees and bushes, and much of it so wet that it was with the utmost difficult that a footman could get through, and totally impossible for teams." Still, Smith thought it "wisdom to make an attempt to build a city."

The Mormons had their choice as to which side of the river they would locate on, and they bought and settled land on both banks. Their ultimate decision was to settle on the Illinois side.

Rip Sparks, an aquatic biologist for the Illinois Natural History Survey at Havana, Illinois, suggests why the Mormons chose to settle where they did. "The bluffs," says Sparks, "must have played a role in their decision to locate in Illinois. On the west bank of the river, there are steep bluffs," which would have made it difficult to load and unload supplies from the flatboats. But, says Sparks, "At Nauvoo the bluffs were set back from the river, and the flatboats were much more accessible."

"Farther down the river," Sparks explains, "are the Keokuk rapids," an extensive shelf of limestone and blue clay that made navigation on the river impossible. "Boats had to off-load before they came to the rapids and there was a good trade to be made from shipping."

In 1839, 5,000 Mormons "invaded" Nauvoo. Soon after settling, construction began on the Mormon Temple, an architectural wonder that would soon be the tallest structure in Illinois. The temple rose out of the bluffs, a beacon to all "God's People" in the last days of life on earth, which the Mormons believed imminent. Nauvoo's population reached 12,000 in 1844, making it the largest city in the state. The Latter Day Saints had their own charter, a special dispensation from the State of Illinois to govern themselves. They even had their own militia, the Nauvoo Legion. But there were big problems looming in paradise.

The tremendous growth of Hancock County due to the Mormon settlement rapidly eroded the political stability of the area. Whig and Democratic politicians worked hard to woo the Mormons to their party platforms, but the Mormons had an agenda of their own. Politicians endorsed by Joseph Smith - most often gentiles who had been friends to the Mormons - were consistently voted into office. The Mormon influence reached its peak in Hancock County in 1844, when Joseph Smith decided to run for President of the United States.

That same year, Smith and his brother Hyrum were murdered at the county jail in Carthage, Illinois, and the Mormons' dreams of a city on the hill were once again dashed. In 1846 under the leadership of Brigham Young, the Mormons began their trek to Utah.

The Mormons, however, would not be the last utopian community to settle in Nauvoo.

Steeple building at Bishop Hill

Voyage of the Icarians

In 1849 the followers of a French social theorist named Etienne Cabet migrated from their utopian settlement on the Red River in Texas to the abandoned city of Nauvoo where they set up their own temporary paradise in the ruins of the Mormon utopia. The Icarians, as they called themselves, took their name from Cabet's book, *The Voyage to Icaria*. Cabet had for forty years been the leader of the French Republican Party, but he had been exiled from his homeland for speaking out against the reign of Louis Philippe. In 1846 Cabet and nearly 300 disciples immigrated to Texas. Life there proved inhospitable, so they regrouped in New Orleans and moved to Nauvoo upon hearing that the Mormons had abandoned their city.

Sunstone from the Nauvoo Temple

The agnostic Icarians' agrarian society was founded on the principle of shared communal property. They were the most democratic of the Illinois utopians and the most family-oriented. At Nauvoo the Icarians bought houses but very little land, since they intended to settle later in Iowa. At one time the Icarian population at Nauvoo reached 1,500, but Cabet and his followers believed an additional 30,000 disciples would eventually immigrate. They never came. Cabet died on a trip to St. Louis in 1856, and the remaining Icarians, frustrated and fractionalized, moved across the river and established a permanent colony near Corning, Iowa.

The Search for Perfection

The Icarians were one of the few utopian societies in America founded on non-theological principles. By far the greater number of utopian communities in the United States during the nineteenth century had origins in the religious persecution taking place in Europe.

Nowhere was this religious immediacy more evident than in Sweden in the 1840s. In the village of Hallsingland, a group of separatists led by a charismatic lay minister named Eric Jannson turned away from the doctrines of the state church of Sweden, the Lutheran Church. For this they were persecuted. Jannson, an itinerant wheat flour merchant, preached a gospel which had antecedents in the primitive Christian church. Contrary to the state church, Jannson affirmed that freedom from sin was possible, and that perfection could be achieved through a life of devotion, work and prayer. Arrested for his heresies, Jannson was jailed six times. His ministry and his church persisted.

In October 1845 the first of the Jannsonite emigres, a man named Olaf Olsson and his family, sailed from Sweden to America to reconnoiter and report back on what he had found. After searching for settlement sites in Wisconsin and Michigan, Olsson arrived in Henry County, Illinois.

Federal land surveyors had mapped the Illinois Territory in 1817 and recorded their descriptions of the Henry County terrain in terse field notes. Their writings were understated and are instructive. Occasionally a surveyor, impressed by what he saw on the wind-swept prairies, would jot down what may have been an emotional response to the landscape, here noting that the soil was "rich" or "good for farming," and there a section was "entirely fit for cultivation."

According to Henry County histories, the woods along the South Edwards Creek abounded in fruit and wil game. Louis Iverson, terrestrial plant ecologist for the Illinois Natural H

(continued on p. 24)

THE GRAND KANKAKEE

Story and Photographs by Thomas E. Rice

The French adventurers carried their canoes on a long and tedious journey overland until they finally came upon flowing waters in what is now northwestern Indiana. It was December 1679, and the explorer La Salle and his 30-man party might have been the first white men to see the Kankakee River.

The Frenchmen launched their canoes and continued their journey on the meandering river through new and strange country. To mark their trail and record their progress for those who might follow, the Frenchmen tied letters to trees at their camp sites along the way.

The explorers started their journey on the Kankakee at the river's beginning near present day South Bend, Indiana. They eventually traveled over the entire run of the Kankakee River - over 300 miles - to where it meets the Des Plaines River and forms the Illinois River.

Today an island in the Kankakee River that La Salle used as a campground is a recreational and historic site for the town of Momence, Illinois. A large group of ducks flocks to anyone who approaches the wooden footbridge that leads to the island, hoping to get a handout of corn or bread. Nearby, proud Canadian geese keep their distance and quietly roam the shoreline.

The people of Momence are very protective of the waterfowl that have made the river and its shores their home. Momence historian Kay Hess says this same type of concern is expressed for the welfare of the river.

Trapper Billy Allgood, who became an authority on the river, lived on the Kankakee's bank near Momence in the 1860s. Kit Carson and many other mountain men and trappers were his friends. (Courtesy: Kay Hess, Momence)

With an encyclopedic mind she relates local history, the legacy of the Indians and settlers that lived in the area, and the importance of the river to the people of the area. "You can't separate the river from history," she says. "It's all one and the same."

The River's Heritage

The Pottawatomi Indians, believed to be the first inhabitants of the Kankakee River basin, called the river *Ti-yar-ac-ke*, "wonderful land." The name was adopted by the French as *The-a-ki-ki*, and *Quin-que-que*. The name Kankakee is thought to be the English version of the later French word. The river and its marshes were a fishing, hunting, and trapping haven for the Indians.

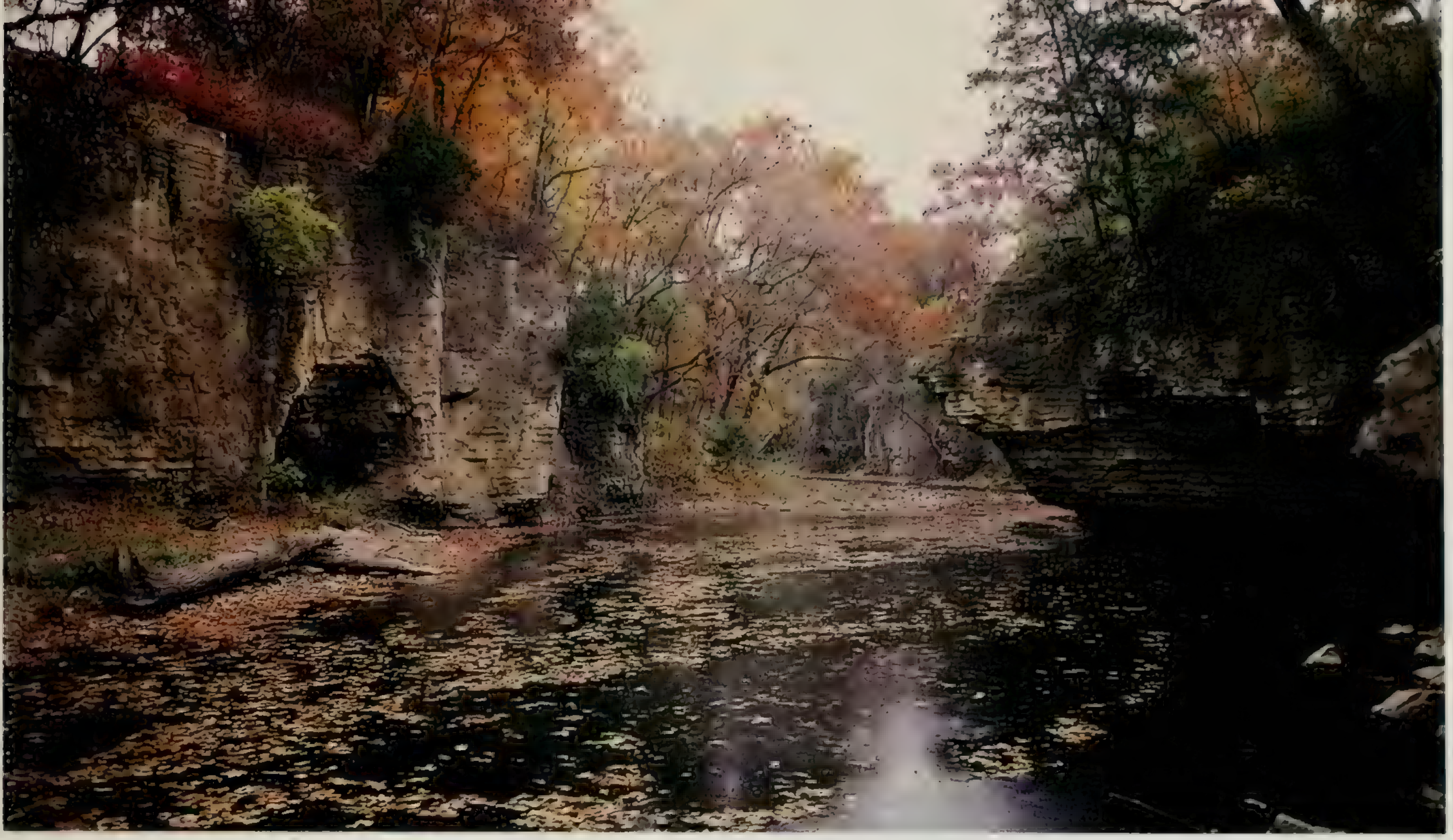
One of the first white settlers in Kankakee County, fur trader Gurdon Hubbard lived and traded with the Pottawatomi for years. His appreciation of the area was reflected in a letter he wrote to the Kankakee Old Settlers' Association in the 1880s: "You are citizens of one of the most beautiful portions of our grand state. I can never forget my first impressions, in 1822 (it was my first visit), as I traveled up that stream (the Kankakee). I thought I had never before enjoyed the sight of so much natural beauty as met my gaze, of river, woods and lands so delightfully interspersed."

But like many others who live on the river today, Kay Hess knows of the creeping problems that have beset the river for many years. She blames much of it on what was done to the river and the Grand Marsh upstream in Indiana.

The Demise of the Grand Marsh

The 400,000 acres of swampland called the Grand Kankakee Marsh once stretched from near South Bend, Indiana, and across the Illinois state line to just east of Momence. Various public and private groups in Indiana used steam dredges beginning in 1906 to drain the marsh and straighten and channel the river so the land could be used for agriculture.

When the work was completed in the spring of 1917, the effect of the drainage on wildlife was devastating. Hundreds of thousands of newly-hatched ducks and



Rock Creek, a tributary of the Kankakee, near Kankakee River State Park

geese died for lack of water. Dead fish lay thick in the drained lagoons. The odor of decaying flesh of beaver, otter, and muskrat was unbearable.

For the Indians, and later the trappers and fishermen who settled in the area, the Marsh had been a good provider. Presidents Grover Cleveland and Theodore Roosevelt, as well as European nobility, had also hunted there. But the Marsh was now gone, and the vast natural habitat and sportsman's paradise was lost.

In the end, 250 miles of meandering river and marshland known worldwide for its beauty and diversity were turned into a straightened, deepened channel 82 miles long. "They murdered the land," concluded an old "swamp rat" who had witnessed the devastation.

In his 1920 book *Tales of a Vanishing River*, Earl Reed lamented the loss of the Grand Marsh area of the Kankakee River. "The Kankakee of old has gone," Reed wrote. "The realization of this great economic wrong must be left to future generations. Man has scarred the earth he lives upon and annihilated its creatures. The Vanishing River moves on through a twilight of ignorance and error."

"Leave the River Alone"

A 1981 report detailing the findings of studies conducted by the Illinois Water, Geological, and Natural History Surveys concluded that the Kankakee River as we see it today is the result of many natural and manmade activities. The channelization of the upper river in Indiana has increased the slope of gradient of the river. This led to an increased sediment load as the river scoured its bed and banks or picked up materials from the watershed. When this increased sediment load was delivered downstream in Illinois, where the gradient had not been changed, the sediment was deposited, forming sandbars or islands.

Fishing the river, Cobb Park at Kankakee, Illinois

This was evident in aerial photos of the river between the Indiana state line and the city of Kankakee. The photos, taken between 1939 and 1954, revealed that increasing sedimentation in the river resulted in the growth of beaches and islands, particularly at the confluence of the Kankakee and Iroquois Rivers.

The sediment (mainly sand) that is accumulating in different parts of the river is a threat to recreation and aquatic life. As the sediment reduces the water storage capacity of the river, shallow waters endanger boat safety and destroy aquatic life.

Sediment continues to travel downstream into Illinois from Indiana. The report of the three Surveys warns that although the river is basically stable in both states, any change will result in an unbalance. "Further dredging, clearing, or construction can lead to more bed and bank erosion and more sediment, and to serious

Swans in the Kankakee River at Aroma Park

disturbance to aquatic life," the report states.

One general conclusion comes from the several preventive or restorative measures recommended by the Surveys: "If at all possible, leave the river alone - work on improving the land around it."

Paying a Debt

Gordon Graves has a deep-rooted appreciation of the Kankakee River. As a lifelong resident of Kankakee, the 75-year-old retired general contractor has a strong personal link to the waters of the river. "The Depression came and my father lost his business," Graves says. "When he died during this period, I was the oldest of four children. I often noticed the river rats as they went out to fish. I started fishing and learned all I could from those old river rats. Then I began selling the fish and I made enough money to survive."

Graves supported his family and eventually prospered. "I owe a debt to the river and I always pay my debts," he says. "I want to protect its natural resources."

For his many years of work to protect and preserve the Kankakee River basin, Graves was honored by President Ronald Reagan at the White House in 1988. The President praised Graves and 93 other winners of the national "Take Pride in America" award for "protecting the abundant majesty of our nation." Graves was one of only 11 individuals who received the award, the others given to schools, businesses and environmental and civic groups.

Although Graves is in the forefront of efforts to preserve and protect the Kankakee, he knows it is going to take a lot more effort and money to correct all that has crippled the river. "It is a long, drawn-out proposition," he says. "I would say the river's situation is terminal."

Illinois has opposed Indiana's alterations of the river in the past. "We've been at war," says Graves. "We've won most of the battles, but not the war. They pulled the plug on the Grand Marsh in 1917 when it was one of the greatest waterfowl and fish habitats in the United States."

Taking Pride in the River

In Illinois, the Kankakee River is still a sturdy, scenic river. Area residents and visitors come to the river to fish, take canoe trips, hike and camp along its shores, or to participate in the many festivals and events on the river.

Between the state line and Momence the river is a meandering stream with a sandy bottom, traversing an area of forests and relatively undisturbed wetlands, known as the Momence Wetlands. These wetlands, which cover nearly 1,800 acres, are one of the largest and finest wetlands remaining in Illinois. Recently the Illinois Department of Conservation acquired a 72-acre portion of the wetlands and designated it a state nature preserve. But most of the wetlands are privately owned and unprotected.

Between the town of Aroma Park and the city of Kankakee, a deep-water area called Six Mile Pool was formed by the construction of the Kankakee dam. The deeper water is ideal for boating.

One of the projects of the Northern Illinois Anglers Association, an environmental group co-founded by Gordon Graves, is the Annual River Cleanup. "We thought the river was a disgrace in some places," Graves explains, "so we decided to clean up the whole damn thing." From the state line all the way downstream to Wilmington, where the river drains into the Illinois River, the cleanup has been organized. Volunteers from many communities collect trash that has accumulated along the riverway.

There are those who believe the Kankakee is dying as a result of the buildup of sedimentation, but they and others who respect the river and what it has to offer continue to hope and work for its survival. ■

OLD IRON

by Susan Post and Michael Jeffords

> *"...buying an engine was quite an era in my life. Ever since I was a boy I have wanted an engine. I have stood for hours watching the motions of those ponderous creatures that move the commerce of the world on sea or land and thought it was every intelligent man's education to understand an engine. After six months of careful study and comparison, I at last with some trepidation, gave the order to have one shipped to me..."*
>
> Pennsylvania thresherman 1871

This 120-year old statement from the Pennsylvania thresherman could be from any member of a steam, tractor or gas engine club of today. There are 30 such organizations now active in Illinois. At first glance these steam and gas engines appear to be ponderous mechanical dinosaurs kept from extinction by a small group of men traveling to festivals, threshings and shows like the medicine men of old, willing to share their knowledge and enthusiasm with all who will listen and question. Beginning in mid-spring and running through autumn, every weekend in Illinois offers at least one antique engine festival, threshing demonstration or historic farming day. Throughout the United States there are over 540 antique farming shows with thousands of participants, all striving to preserve a piece of the past.

Men and Machines

The list of men and their machines is endless. Richard Post, a founding member of the Tazewell County Olde Threshers Association, had always wanted a hit-and-miss John Deere gasoline engine like his father used to pump water. This was the first engine he bought and restored. His collection now includes over 100 such machines.

Taking a break before threshing, Tazewell County, mid-1930s

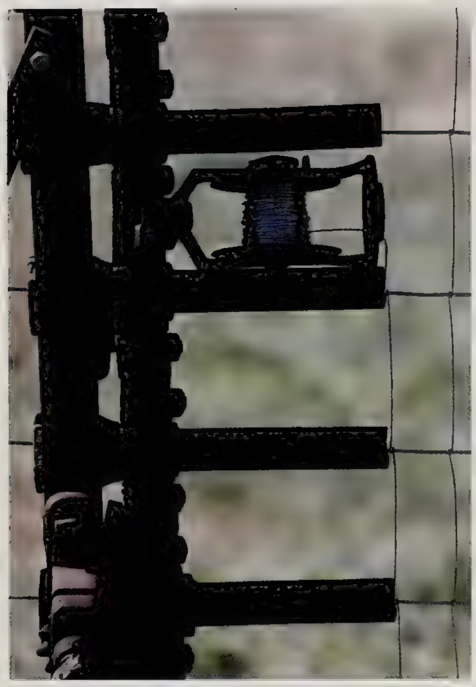
At a recent show in Jacksonville, an Iowa man demonstrated the "art" of fencemaking. Simply by turning a crank, an intricate-looking collection of gears twisted wire this way and that as it traveled vertically along prestrung wires. New fence rapidly appeared to the obvious delight of the operator. He had started his hobby 40 years ago after picking up a piece of homemade hogwire in his neighbor's junk pile and wondering how it was made. Six years ago he bought the fencemaking equipment at a farm sale.

The first portable steam engine designed for agricultural purposes was manufactured in 1849. "Portable" meant a team of four to six horses could haul it through the woods or across the fields. By the 1870s, self-propelled steam engines had reached the farm. Advertisements boasted that the steam engine could be conveniently moved from place to place and set up as readily as a common cook stove. Today, a semi-trailer truck hauls these still portable engines to the various demonstrations. Before an engine can be used, the boiler must be washed, fittings greased and oiled, and a fire built in the firebox. Patience is required to "wait for gettin' up steam" so the engine can go.

Smoke, Steam and Sparks

The sight of a portable steam engine at work in 1874 was not a scene to instill confidence into the hearts of the timid or uninformed. These iron and steel contraptions loaded with a bellyful of fire and sending forth smoke, steam and sparks tended to command respect and occasionally fear. Even when the engine stood idle, the escaping steam from the hot boiler sizzled out through leaky valves and pumps in an ominous manner. The inexperienced person held it in mortal dread as an infernal machine of potential death and destruction, reminiscent of an encounter between Saint George and the dragon. The machines make even modern day observers uneasy. Clouds of dark smoke and sooty black water belch from the long smokestack and steam hisses from the valves. The long belt that connects the steam engine to the thresher is taut and dangerous-looking.

The boom of the steam engine was from 1885 to 1912, peaking in 1910. During the 1920s and 1930s steam engines were pushed aside to slowly accumulate in junkyards or rust in the fence rows. The metal scrap drives of World War II almost eliminated these engines from the American scene. A few men who never lost their love for steam engines were able to keep them by proving to the local scrapdrive authorities that these machines were still in working condition. By the late 1940s, men were demonstrating the art of threshing at special threshing bees and local fairs. In 1948 Pontiac, Illinois held the first an Thresherman's Reunion. Because th



Fence-making machine

operation of these machines is so unusual, their performance still attracts considerable interest. The Tazewell County club offers a Steam Engineers School. The school has both classroom and hands-on training in the steam tractor engine. The class is designed to create an interest in and respect for the steam engine and its unique role in the growth of American agriculture.

Steam Versus Gas

The transition on the farm from steam power to gasoline was part of an inevitable cycle of progress by the American farmer. The desire to do his work more easily, efficiently and economically spelled the doom of steam as a power source on the farm. The stationary gasoline engine could provide power at a moment's notice. It was safe, reliable, easy to operate and truly portable. Operation was possible both indoors and out. Gasoline-powered tractors took over as the chief source of power on the farm around 1913. Prior to this, most tractors were large, heavy and unwieldy. They had been built from the same patterns as their steam predecessors, only with a gas engine substituted for a steam engine and boiler. With the introduction of smaller tractors and Henry Ford's automotive system of mass production, gasoline tractors became the workhorse of the farm. Tractor shows soon became the order of the day with a circuit of plowing demonstrations. As many as 50,000 people attended these shows to tramp up and down the fields watching the new tractors perform. Today the engine clubs stage plowing bees and slow races (the object is to run the tractor as slowly as possible, last one in wins) to showcase their lovingly restored machines.

"Good Old Days"

Like the prairie, the early methods and equipment of farming are being preserved. Gas engine and steam clubs hold Thresherman's Reunions and Grandpa's Days on the farm to demonstrate the equipment and old-time farming skills. Threshing oats and wheat with steam and gas, shockloading with horse-drawn bundle wagons, tractor and horse plowing, corn-shelling and grinding, and log-sawing are only a few of the attractions. Antique tractors and stationary gas engines are displayed, and if they demonstrate a labor-saving chore, so much the better. One enterprising youth hooked his Maytag engine up to a wringer washer and proceeded to do his week's laundry with lye soap.

The Tazewell County group holds their annual show on the Al Beutel farm near Tremont. Al plants four acres of oats to be cut with an antique binder for this special threshing day. Al remarked that it takes four days to do something that his modern equipment could do in less than an hour. The smile, however, belies the good-natured grumbling. The "good old days" of farming bring a warm and wonderful feeling to the participants, keeping alive the heritage of rural America.

When antique gas engine collector Richard Post was asked if he would like to "pitch some straw" to get the feel of what it's like, he answered with a wry smile and a shake of the head. "No thanks. I remember." ■

*Susan Post and Michael Jeffords are scientists at INHS. Michael Jeffords is staff photographer for **The Nature of Illinois***

HARRISON MACHINE WORKS

"Portable" tractor heading for the fields (photo by Susan Post)

SURVEYING ILLINOIS

BIORHYTHMS

A Kinder, Gentler Army

Rare cactus growing at Savanna Army Depot near Savanna, Illinois (Courtesy: INHS)

Threatened and endangered species at approximately 60 U.S. Army installations east of the Mississippi River are the subject of a new annotated directory developed by the Illinois Natural History Survey (INHS). Under the Endangered Species Act, federal agencies including the Army are required to protect any such species under their control. Survey researchers provided the Army with specific information about species and habitats at military installations, including species management and recovery strategies.

A Bear Market For Rabbits

Cottontails in a specific area of Robert Allerton Park in Piatt County were inventoried by INHS for the 33rd consecutive year this fall. This unique rabbit census represents one of the longest continuous collections of data on annual fluctuations in local abundance of Midwest cottontails. Populations crashed in the late 1970s and rabbits did not redux at all in the winter of 1981-1982. Recolonization occurred in the spring/summer of 1982 and has been followed by a slow recovery. Old ideas of rabbit numbers affected by equilibrium, regulation of abundance and balance of nature have been rejected by researchers. Abundance is now thought to be determined more by changes in survival and dispersal and less by reproduction.

Toxicity Testing

The toxicity of 10 common waste disposal contaminants can now be measured with a six-test battery developed by a team of INHS researchers. Few toxicity tests can be conducted with small samples, low-cost testing periods and high statistical reliability, which is exactly what is needed when a variety of environmental contaminants must be monitored. The Survey's new testing techniques meet these needs and will soon be used on samples collected from waste disposal landfills.

Maples To the Left, Pines To the Right

Concern about the greenhouse effect, habitat fragmentation and loss of biodiversity has generated new interest in tree planting. Survey scientists caution about the importance of proper species selection and location. Too many of the same kind of tree leaves the newly forested landscape highly vulnerable to disease, while some species will simply not adapt well to certain locations. Those communities planning tree planting campaigns should obtain forestry management expertise.

Street scene with trees (Courtesy: INHS)

Lepidoptera Come To Light

Monarch butterfly (Courtesy: INHS)

The Natural History Survey's Illinois *Lepidoptera* database collects historic information on the state's approximately 2,000 species of moths and butterflies. Records obtained from visits to 13 institutional and private collections covering 470 locales and the period 1876-1988 are now being computerized. This information will help to identify species that should be placed on Illinois' endangered species list.

CURRENTS

Good Fishing

The state-operated Jake Wolf Memorial Fish Hatchery near Manito needs a plentiful water supply for the tanks and ponds it uses to breed over 40 million fish each year.

In a study of groundwater withdrawals at the fish hatchery, the Illinois Water Survey is addressing concerns about the effects of heavy withdrawals on the area's aquifers and the efficiency of the hatchery's wells after years of pumping. Researchers have installed groundwater monitoring wells near the hatchery, and ongoing tests will be conducted to determine if there is any deterioration in the hatchery's wells.

Left: Just hatched fish at Jake Wolf Hatchery. Right: Egg hatching jar containing 200,000 walleye eggs (Courtesy: Illinois Department of Conservation)

Storm brewing (Courtesy: IWS)

The Weather In Three Dimensions

Illinois Water Survey researchers study the atmosphere and its changing weather using advanced radar, aircraft stocked with sophisticated instruments and a variety of other equipment. With the help of a grant from AT&T, scientists will now be able to generate three-dimensional illustrations from the vast amounts of meteorological data they have collected on computer screens.

Computers can, for example, process data on radar-tracked clouds in a developing storm system and transmit that data to a high-powered computer that calculates such cloud properties as color, shading and transparency. The clouds then appear as three-dimensional shaded objects on the screen.

These illustrations will enable scientists to visualize the inside of a developing storm and study the nature of such components as ice particles, temperature, humidity and wind.

The Big Picture On Groundwater

Groundwater contamination problems are common to most areas of Illinois and the nation, and monitoring of groundwater quality has become a critical issue.

Water Survey researchers are conducting a three-year study of groundwater monitoring methods at Sand Ridge State Forest in Mason County and at an industrial site near Beardstown. Project activities involve purging and sampling monitoring wells, taking more than 2,000 measurements of groundwater levels, and conducting more than 55,000 chemical analyses.

The critical finding was that groundwater quality in shallow sand-and-gravel aquifers varies substantially with time, even in the absence of contamination. One-time "snapshots" of groundwater conditions can be quite misleading as to the actual quality of groundwater near sites of high water use or near likely sources of chemical contamination.

Preparing to monitor a well at Sand Ridge State Forest (Courtesy: IWS)

Hydrogeological factors must be carefully considered in all monitoring efforts. If monitoring is properly designed and conducted, most routine quality assurance measures required by state and federal agencies should be sufficient. Results from the investigation can be applied to monitoring efforts worldwide.

GEOGRAMS

Reducing the Risk

When the Illinois Department of Transportation (IDOT) considers buying or building on a site, it turns to the Illinois Geological Survey for information on manmade or natural hazards.

These hazards include location of landslide-prone areas, expansive soils, landfills and mined-out areas. As many as 300 environmental site assessments will be conducted during the contract year.

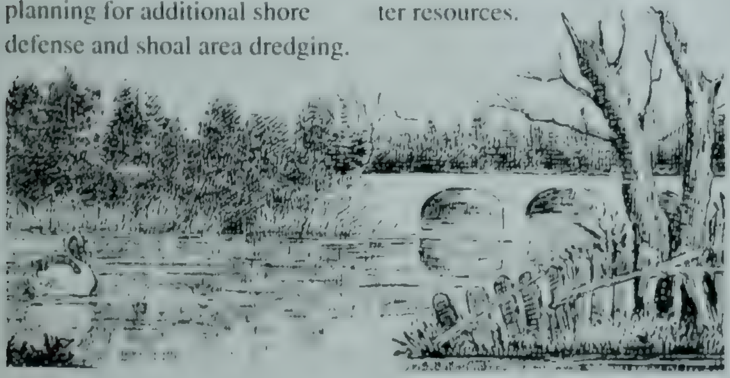
The Survey collects information for its reports from its geologic and hydrogeologic databases, review of historical documents and computerized geographic information systems, on-site inspections, and limited field analysis of soil, water and air.

Twenty Thousand Leagues Under The Lake

Coastal sedimentary changes near the newly constructed North Point Marina on Lake Michigan, adjacent to the Illinois-Wisconsin state line, are being measured. This effort will identify shoreline, beach and lake bottom alterations as the coastal zone adjusts to the construction of the marina breakwaters. Surveys in 1988 and 1989 documented lake bottom changes. Shoreline and beach alterations continue to be measured weekly. This information will be used by marina engineers and managers in planning for additional shore defense and shoal area dredging.

Surface Waste and Shallow Groundwater

A series of statewide maps have been compiled by the Geological Survey for the Hazardous Waste Center showing the density of current waste generation and disposal activities. Using the Geographic Information System (a computerized natural resources database), these maps were overlain with a map showing the potential for contamination of aquifers in Illinois. These composite maps identify areas where the density of current waste activities may be a significant threat to groundwater resources.



Lake Michigan From The Air

Lake Michigan from the air (Courtesy: IGS)

Photographic documentation of Lake Michigan's shoreline changes is part of a two-decade program at the Geological Survey. To record changes along the shoreline during the summer of 1988, scientists flew the area and took 1,100 color transparencies.

Again in May 1989 a photo flight was made over the Illinois shoreline with extensions into Wisconsin and down the Illinois Waterway. Over 3,000 aerial color slides were collected in addition to 500 ground slides. The Survey photo collections are used to respond to public inquiries about rates of shoreline erosion and location and condition of shore-defense structures, as well as supplying basic data to researchers.

The Aggregate Industry

The production of aggregate for construction is a major industry in the Chicago metropolitan area. In recent years depletion of known resources and urban encroachment on undeveloped sites have resulted in an uncertain future for the industry.

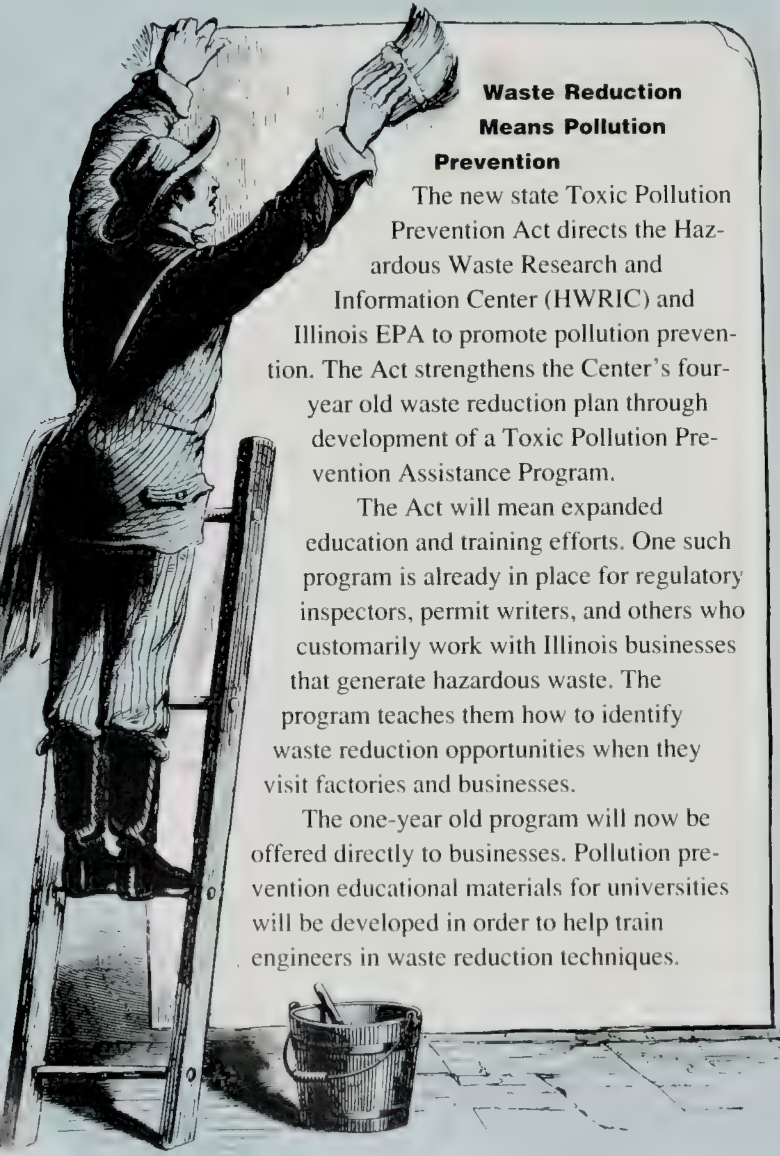
To identify additional sources of aggregate and to assist quarry operators, the Survey is studying existing quarries and exposures, along with subsurface cores in northeastern Illinois, to provide a good picture of the area's geology.

Dr. Don Mikulic of IGS studies quarry in northeastern Illinoi (Courtesy: IGS)

CENTERING ON WASTE

New Publications To Aid Businesses

"Management of Used Lead-Acid Batteries" is the first in a series of new fact sheets developed by HWRIC. The fact sheet discusses regulations governing disposal of these batteries, how auto maintenance shops and other users can better manage batteries, and gives general recycling information. The second fact sheet (available February 1990) will cover regulation, management and recyling options for used oil. For more information, call HWRIC at 217/333-8940.



Waste Reduction Means Pollution Prevention

The new state Toxic Pollution Prevention Act directs the Hazardous Waste Research and Information Center (HWRIC) and Illinois EPA to promote pollution prevention. The Act strengthens the Center's four-year old waste reduction plan through development of a Toxic Pollution Prevention Assistance Program.

The Act will mean expanded education and training efforts. One such program is already in place for regulatory inspectors, permit writers, and others who customarily work with Illinois businesses that generate hazardous waste. The program teaches them how to identify waste reduction opportunities when they visit factories and businesses.

The one-year old program will now be offered directly to businesses. Pollution prevention educational materials for universities will be developed in order to help train engineers in waste reduction techniques.

The WRITE Stuff

MPI Label Systems specialist and HWRIC engineers discuss MPI's printing line (Courtesy: HWRIC)

Chosen for a $300,000 three-year national waste reduction research program by USEPA, the Hazardous Waste Center will work with selected industries to demonstrate and evaluate five or more new options for reducing industrial wastes.

The Center is negotiating with several companies to work on WRITE (Waste Reduction Innovative Technology) projects. One of these is Danforth Corporation of Elk Grove, an electroplating operation that is experimenting with a method to reduce both waste volume and toxicity. Danforth plans to substitute zinc hydroxide for zinc cyanide in its electroplating solution, eliminating the use of a highly hazardous solution and saving money. Recyling the zinc hydroxide solution is also a priority.

MPI Label Systems of Monee will save more than $6,000 per year by switching from volatile solvent-based inks to water-based inks in its label-printing process. This will increase worker safety and decrease waste. MPI also plans to use a citrus-based cleaner in place of a chlorinated solvent cleaner for its flexigraphic printing presses.

The American Foundrymen's Society of Des Plaines is assisting in the development of a method to recycle zircon sand, a vital material in the investment casting process. This minimizes use of an important material and reduces waste sent to landfills.

BREATHLESS

Chemically defined as a form of oxygen with three oxygen atoms instead of the two found in regular oxygen, ozone is the Jekyll and Hyde of the atmosphere. In the upper atmosphere, the ozone layer absorbs and offers protection from ultraviolet radiation. It is a benefactor to mankind and is in danger from a variety of manmade sources. At ground level ozone is a harmful pollutant. Both natural and manmade ozone are the result of sunlight acting on gases in the atmosphere, occurring in roughly equal parts in the environment.

Lake Shore Drive on a smoggy afternoon

Elusive and Mobile

Manmade ozone is an urban creature, in environmental parlance a secondary pollutant. It doesn't come from any one direct source, but instead is formed when volatile organic compounds (VOCs) like benzene and nitrogen oxides interact and are baked in sunlight. The resulting stew is popularly known as smog. Ozone is the largest part of that unsavory mixture.

Ozone precursors are emitted from large and small sources, both stationary and mobile. Household products, dry cleaners, petroleum refineries, oil storage tanks, chemical manufacturers, printing industries, and America's beloved automobile all contribute. Recent estimates point a finger at automotive vehicles as the source for over half of the ozone-creating compounds in the Chicago area atmosphere, with large industrial plants accounting for another 20 percent.

Southern California, the East Coast, Texas and Chicago are all major ozone producers. Not only do these areas manufacture ozone, they export it. Ozone travels. In Chicago it bakes south of the city, rises into the atmosphere during the day and then rides the air currents to Evanston, the northern suburbs, and, no respecter of state boundaries, drifts up to Racine and Kenosha. Lake Michigan's off-shore winds complicate an already unstable meteorological mess.

Chicago's ozone season lasts from April through October, with the highest concentrations measured in June, July and August. Ozone levels are generally high during hot summers, low during cool summers. No fewer than 20 ozone alerts were prompted by the unseasonably hot summer of 1988, while last summer's cool weather elicited only four

Corrosive and Dangerous

According to the U.S. Environmental Protection Agency (USEPA), ozone is particularly dangerous for the young, the old and those with upper respiratory ailments. New findings indicate that it also has significant adverse health effects for large segments of the normal healthy population.

The national standard for ozone is .12 parts per million (ppm) averaged over a one-hour period. In a series of studies conducted on people with healthy lungs, federal researchers found that ozone exposures as low as .12 ppm administered for one to three hours, coupled with intermittent heavy exercise, can reduce normal lung functioning by 10 percent or more in about 5 to 20 percent of the subjects tested, including both adults and children.

At concentration levels from .12 ppm to greater than .20 ppm, healthy subjects experienced chest pain, coughing, wheezing, pulmonary and nasal congestion, labored breathing, sore throat, nausea and increased respiratory rate.

Permanent lung structure damage has been observed in animals exposed to ozone levels of .20 ppm.

Studies conducted by USEPA's National Crop Loss Assessment Network established that flora as well as fauna is in danger from ozone. Major cash crops such as soybeans, peanuts, corn and wheat suffer 10 percent or higher yield losses when the average seven-hour daylight ozone concentration during the growing season exceeds .04-.05 ppm. Other studies have shown reduced plant yields of up to 33 percent in tomatoes, 26 percent in beans, 20 percent in soybeans and 22 percent in snapbeans. Federal researchers estimate potential crop losses due to ozone at two to three billion dollars annually.

Ozone is also a major suspect in the decline of the San Bernardino National Forest in southern California and in damage to pine and spruce forests in the eastern United States.

Ozone can also attack nonbiological materials. Elastomers, textile fibers and dyes, and certain types of paint are particularly susceptible.

Regulated But Still Pervasive

When Congress passed the Clean Air Act in 1970, the USEPA Administrator set National Ambient Air Quality Standards (NAAQS) for six air pollutants: sulfur dioxide, nitrogen dioxide, particulate matter, lead, ozone and carbon monoxide. The standard for ozone is .12 ppm. Ozone levels are measured at 39 sites in Illinois, with the greatest number of standard violations occurring in Chicago and the Metro-East St. Louis area. Neither Chicago nor the Metro-East area has yet met the national standards for ozone.

Progress has been made. According to Illinois EPA (IEPA), from 1979 through 1986, a reduction in ozone emissions of 38.3 percent was achieved in the area covered by Cook, Lake, Kane, DuPage, Will and McHenry counties. During the same period, actual VOC emissions declined from 519,235 tons per year to 320,204 tons per year. Of six counties classified as nonattainment for ozone in 1977 - Cook, Lake, Kane, DuPage, Will and McHenry - only two (Cook and Lake) are now in monitored nonattainment.

It would be an understatement to say that 1988 was a bad year for ozone. Record heat and drought regionwide brought more ozone exceedances in Illinois than in any of the last 10 years and the first yellow ozone alert since 1978. It was a particularly bad year for Lake Michigan's western shores, with eastern Wisconsin recording 146 exceedances at 15 sites on 28 days. The Racine-Kenosha areas were especially hard-hit. By comparison Illinois experienced a total of 88 ozone exceedances at 23 sites on 32 days.

Wisconsin, convinced that its neighbor to the south wasn't progressing far enough or fast enough in its ozone reduction plans, sued USEPA in federal court. It asked U.S. District Court Judge Terence T. Evans to force the federal agency to formulate its own plan for ozone control in Chicago. The judge agreed, and in January, 1989, USEPA found itself in the unenviable position of having only 14 months to develop a crash ozone control program.

Crash it did. Visions of such draconian measures as carless days and manufacturing restrictions made Chicagoans sit up and take notice. The numbers generated by USEPA kept changing as individual industries challenged their statistics. Almost everyone agreed that Lake Michigan's meteorological mysteries were contributing to the problem, but how, where and how much?

Settling and Re-regulating

The federal agency was unprepared, even reluctant, to formulate a plan it believed to be a state responsibility. Incongruously, at the same time the federal government was looking at sanctions for Illinois' delays, a federal audit of Illinois' automobile inspection and maintenance program found it to be one of the best in the country.

In October the uncertainty came to an end with an announcement that USEPA, Illinois and Wisconsin had settled the lawsuit.

According to Bernard Killian, IEPA Director, the agreement has four key parts. The first is that Illinois will improve its auto inspection and maintenance program. This could mean geographically expanding the program into western DuPage, eastern Kane and portions of Kendall, Will and McHenry counties, or adding various checks on a car's anti-pollution equipment, or some combination thereof. This program, which requires approval by the General Assembly, must be enacted into law by December 31, 1990 or the state faces federal sanctions.

The second element of the suit calls for Illinois and USEPA to cooperate in reworking the state's RACT (Reasonable Available Control Technology) rules. Various industry exemptions granted by the Illinois Pollution Control Board will probably come to an end, bringing more and smaller industries under the regulatory gun for hydrocarbon emissions. Illinois must revise its RACT rules by December 31, 1990 or USEPA will do it for the

Runners near the finish of a 10k race

Ozone damage to bean leaf

"The cornerstone of the plan calls for a much more thorough urban airshed modeling effort than we've ever tried before," explains Killian. "Illinois, Wisconsin, Indiana, Michigan and USEPA must work together to develop a photochemical reactive grid model that will more correctly account for the lake's meteorological effects on ozone transport in the region. The model we use now (EKMA) has a plus or minus 30 percent degree of accuracy. Its chemical analysis is O.K., but the meteorology is definitely not."

The four-year modeling effort carries a price tag of $12 million, with USEPA picking up one-third of the cost, Illinois picking up 72 percent of the non-federal contribution and the other states paying the remainder. The states have three tasks: compilation of an inventory of all sources of ozone precursors in the region, meteorological modeling, and finally, more controls.

"The last part of the settlement states that if Congress changes standards and sets new deadlines, Illinois would proceed on that basis, except for the modeling. We really need that information, and we'll go forward with that no matter what," Killian states.

Reauthorization of the Clean Air Act by Congress is the wild card in every state's air pollution control strategy. Both House and Senate committees are looking at new car standards that would apply California's strict auto exhaust rules to the entire country, use of cleaner alternative fuels, and new deadlines. Those deadlines don't only affect ozone programs, but acid rain, air toxics and global warming efforts as well.

"Right now Congress doesn't seem to be heading in any direction clearly enough for me to see the general shape of a new Clean Air Act. Best case for a full program to emerge is in the spring," Killian reports.

Researching

Supplementing IEPA's ozone efforts is an ozone research agenda developed by the Illinois Department of Energy and Natural Resources (DENR). One major study just begun is an inventory of VOC emitters, with data on their full potential for VOC emissions. The study is looking at industrial, area and mobile sources of hydrocarbons, nitrogen oxides and carbon monoxide in order to provide a point of comparison for inventories already in place. The area to be surveyed includes the northeastern eight counties of Illinois.

A second major study is well underway. This tests an innovative inventory technique for mobile sources (motor vehicles) based upon a new remote sensing process.

Automobiles pass through an infrared beam that splits, rejoins and takes measurements at the exhaust plume of the vehicle. The measurements are recorded on computers and license plate numbers are videotaped.

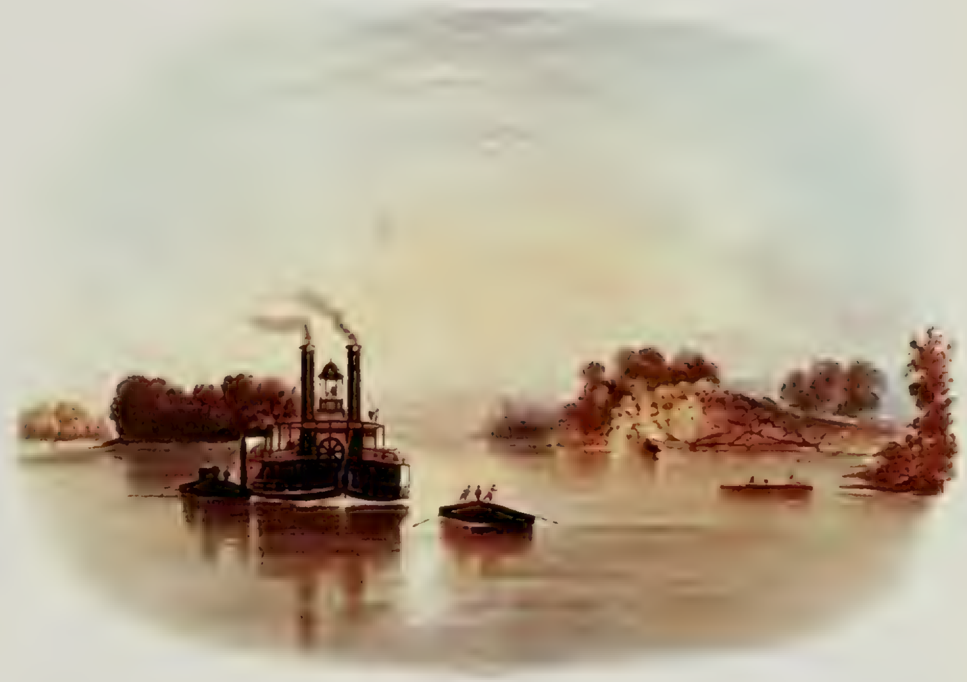
Data has already been collected on 12,000 cars at an entrance ramp onto Chicago's Eisenhower Expressway last August. A measurement of the amount of carbon monoxide in the exhaust coming from each vehicle was collected. Dr. Donald Stedman, an atmospheric chemist at the University of Denver, designed and conducted the study.

"Preliminary results indicate that 10 percent of the vehicles measured were causing 50 percent of the pollution. The data is now being subjected to a further analysis that will reveal what proportion of that 10 percent are older automobiles," according to Bill Denham of DENR. "We're confident that these studies will make a positive contribution toward Illinois' ozone control strategies."

The hazy picture on ozone may be getting a little clearer. ■

KARL BODMER'S ILLINOIS

Twenty-three year old Swiss draftsman and embryonic landscape painter Karl Bodmer landed at Boston Harbor on July 4, 1832. Neither he nor his fifty-one year old German patron, Prince Alexander Philipp Maximilian, dreamed that the pictures Bodmer made and the words Maximilian wrote would become the world's most admired and respected record of a new land and its people. Before Bodmer the novice began his work, several experienced American artists had recorded their impressions of the untamed, awesome land west of the Appalachian Mountains, its settlers and its native Americans. Experts seem to agree that Bodmer's work captures quality and depth beyond the reach of all others.



Cave-in-Rock, View on the Ohio (Courtesy: Joslyn Art Museum, Omaha, Nebraska)

Awesome Landscape and Passionate People

It was Bodmer who captured the haunting essence of a diverse land and its contending cultures. It was Bodmer alone who captured for history the raw magic of a land and its people as the Maximilian Expedition moved along the often fearful rivers and primitive trails from the East Coast to Fort McKenzie at the headwaters of the Missouri in present day Montana between 1832 and 1834.

Maximilian was a product of the German renaissance in science. As was the case with many educated Europeans of his class, he was a naturalist who already had explored parts of South America. His special interest was zoology. He collected specimens (transporting a caged bear for thousands of miles from the near west where the creature was captured, to the far west and then to the East Coast), and he was an ethnologist when ethnology was still a very young science.

Many of Karl Bodmer's most acclaimed works are meticulous visual studies of native Americans and the symbols, rituals and tools of their cultures. That is what Maximilian expected of the virtually untrained young man he chose to accompany him as illustrator. Art experts assume that Maximilian was simply lucky when "a friend of a friend" mentioned a young aquatint engraver apprentice named Bodmer as a possible artist and traveling companion. Nothing achieved in his life before the expedition foretold Bodmer's talent - his eerie ability to perceive and record the nuances of the American frontier and its inhabitants.

"From the standpoint of an anthropologist," said Dr. W. Raymond Wood of the University of Missouri at Columbia, "Bodmer's greatest legacy is his portraits of the Indians of the Great Plains. His meticulous attention to detail tells us a story that otherwise would have been lost forever." Wood has studied and lectured on the Indians of the Great Plains for thirty years.

"Bodmer's colors are laid on with extreme care and in such detail that certain very small features, such as the beadwork, can be missed in careless reproductions," writes William H. Goetzmann in the Introduction to *Karl Bodmer's America* (published by the University of Nebraska Press in 1984). A professor of history at the University of Texas in Austin, Goetzmann speaks of Bodmer's Indian portraits as an accurate record of an "archaic language" - each detail of dress conveying symbolic significance. To this day, the artist's subtle messages are being translated by scholars.

Karl Bodmer in Illinois

The Prince planned to stop at New Harmony, Indiana to visit with entomologist Thomas Say who had shared Stephen Long's expedition west in 1819. Maximilian became ill soon after they arrived i October of 1832. Their five-month allowed Bodmer to explore southeastern Illinois at his leisure and to make a two-month trip to New Orleans alone (Maximilian avoided exposure to cholera by remaining at New Harmony).

Perhaps this quiet period contributed to Bodmer's deep realization that he was indeed seeing a new world. Biographer William J. Orr says it was at this point in his long journey that Bodmer's work changed dramatically. The influence of classical European style landscape painting, evident in the work he did between the East Coast and the frontier, dropped away. The raw energy and mystery of the land and its primitive settlements are captured in the pictures he began to paint at New Harmony and continue to the end of the expedition more than a year and a half later.

David C. Hunt, a curator at the Joslyn Art Museum in Omaha, Nebraska, annotated many of the 359 watercolor, pen-and-ink and pencil drawings reproduced in the Bodmer book. Hunt says the artist's dramatic representations of the forested banks of the Fox and Wabash Rivers (White, Wayne, Clay and Richland counties) reveal a love of nature that increasingly characterized his later career as a landscape painter in Europe. These more leisurely months also gave Bodmer time to work in the mode of European artists of the time. Maximilian's journals reveal that the artist returned again and again to the same site; working and reworking his picture, adding depth, character and raw passion to his vision of the untouched terrain. Bodmer is said to have complained to his patron that he could have produced twice the work had he been able to use oils rather than "too intricate" watercolors which required that there be "spaces left behind."

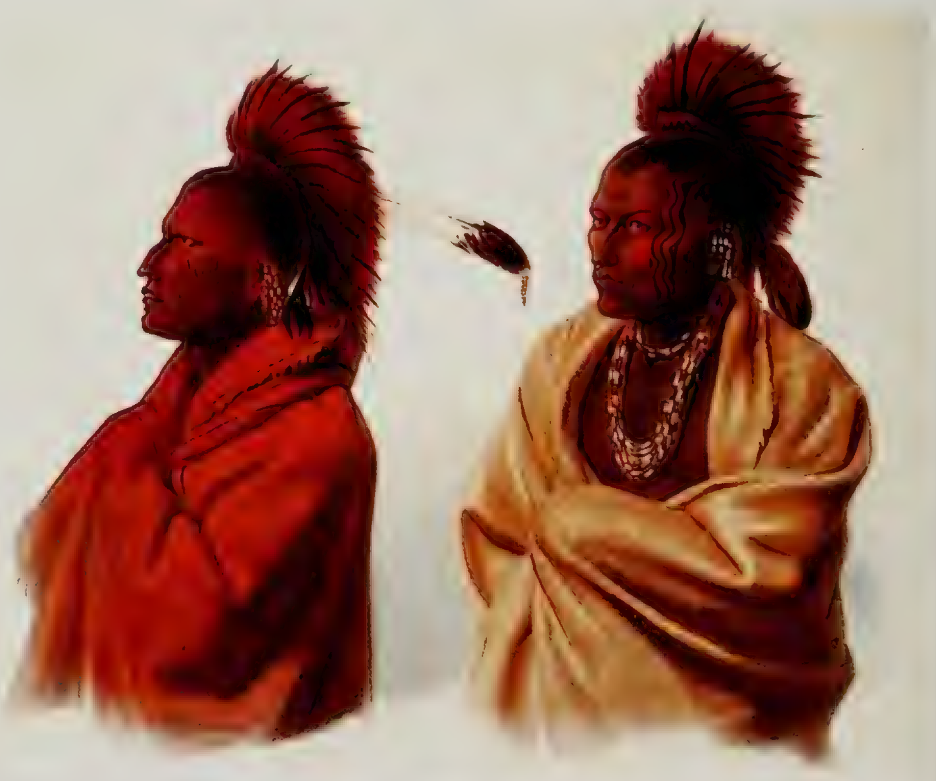
The Prince was nearly twice Bodmer's age and saw the new land differently, sometimes sadly. "By way of settlement," his journal says, "we may preserve here in America neither the aborigines nor the wild beasts because the beginning of settlement is always the destruction of everything. The elks, bears and beavers have already vanished and the rest will follow soon." His royal origins are revealed when he speaks of his "canoe man" explaining "Congress land" where people can fell trees "without permission or punishment." As for the "aborigines," at this point in his adventure, Maximilian could not know that in 1837 smallpox would devastate western tribes of native Americans at the height of their cultures.

If Bodmer's principal legacy is his visual record of native Americans, he saw few of the many inhabiting Illinois before it became a state in 1818. When the expedition stopped at St. Louis in March of 1833, Bodmer was able to do a portrait of Fox Indian Chief Keokuk and a Sauk leader who were there to plead for the life of their imprisoned compatriot, Black Hawk. The Prince's journal says these were the first "wild" North American Indians his party had seen.

Bodmer the Man

Rejection of a proposed contract was the way the lifelong relationship between Bodmer and Maximilian began. To illustrate the trip, Bodmer wanted more money (45 instead of 33 thalers per month), first rights to some of his art, and permission to exhibit before Maximilian's "Atlas" of the trip was published. The Prince acquiesced to the unproven artist's demands except in keeping first rights to most animal and people pictures. Maximilian's growing admiration for Bodmer's work is certain. Journal entries indicate that the Prince found Bodmer an interesting, intelligent companion during the often difficult and dangerous conditions of their two-year journey together.

Bodmer was never able to persuade Maximilian to publish a record of



Massika, Saki Indian: Wakusasse, Musquake Indian (Courtesy: Joslyn Art Museum, Omaha, Nebraska) their trip that was moderately priced. Successive versions in various languages were published between 1839 and 1843. Retained by the Prince, Bodmer was involved in producing and promoting each version. None was a financial success nor of particular interest to a European audience. Until his death in 1867 Maximilian encouraged and frequently subsidized Bodmer, enabling him to pursue excellence in his chosen medium - oils. For a time, Bodmer was quite successful and financially independent.

Biographers say that Bodmer's overpowering need for security prevailed in his later years, restricting him within the conventions of the European artstyle of the time. His talent soared only during his youth, those two years in North America.

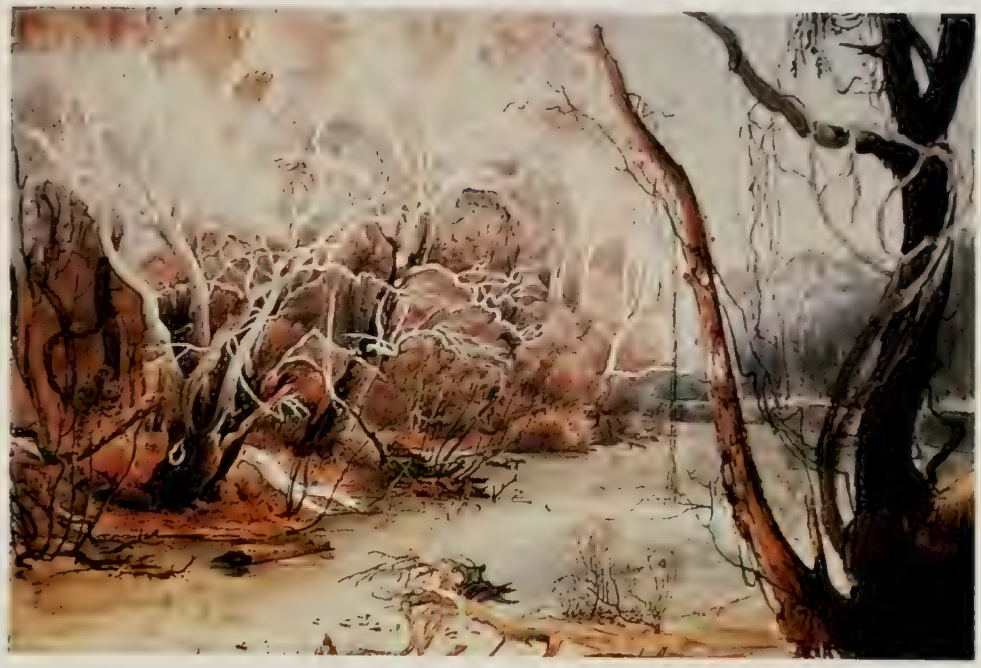
Various illnesses plagued Bodmer during the last years of his life. He continued to work without acclaim. At the time of his death in 1893, he was deaf, blind and impoverished.

Recognition at Last

After World War II, Maximilian's heirs found 400 Bodmer prints stored at the family estate on the Rhine River. In 1959 they were sold to a New York art firm. The Northern Natural Gas Company (now InterNorth, Inc.) purchased the collection in 1962 and placed it on permanent loan at the Joslyn Art Museum in Omaha, Nebraska.

Karl Bodmer's America is the result of intensive research and study by scores of specialists determined to preserve the early history of the United States. The book can be purchased through the Joslyn Art Museum Gift Shop, 2200 Dodge Street, Omaha, Nebraska, 68102.

In Illinois, 40 Bodmer watercolors and sketches can be seen at the Newberry Library in Chicago. ■



The Fox River near New Harmony (Courtesy: Joslyn Art Museum, Omaha, Nebraska)

A Collection of Mysteries

Prince Maximilian, in the company of fellow naturalists Thomas Say and Charles Lesueur, made frequent specimen-hunting forays into the unsettled lands around New Harmony, Indiana. Whether any of the specimens collected by the three early scientists during the winter of 1833 still exist is an open question.

Kevin Cummings, with the Illinois Natural History Survey (INHS), and Bill McKnight, a curator at the Indiana State Museum who was with INHS until 1987, intend to further examine scores of dusty boxes long stored on the second floor of the Workingmen's Institute and Library at New Harmony. The two researchers are convinced that these boxes contain 8,000 to 10,000 animal bones, fossils, Indian artifacts and freshwater shells wrapped in 1800s newspapers. They are further convinced that the collection belongs to Thomas Say, and they are hopeful that thorough examination of the boxes will yield solid proof of Say's association with Maximilian.

"With such a priceless collection, you can't just plunge in. If you did, you could destroy notations that would prove origin," Cummings warns. It may be that notes written by Lucy Say for her husband will prove when, where and who collected the items. "We know these are some of the earliest collections from what was then the western wilderness," McKnight states.

Efforts to link this collection to Maximilian may prove futile, but any record of collaboration among the three men would be very valuable. The ultimate resting place of Say's collections, and of specimens collected by Say, Lesueur and Maximilian remains a mystery. The dusty, dirty boxes stored at the Workingmen's Institute may yet yield treasures instead of mysteries.

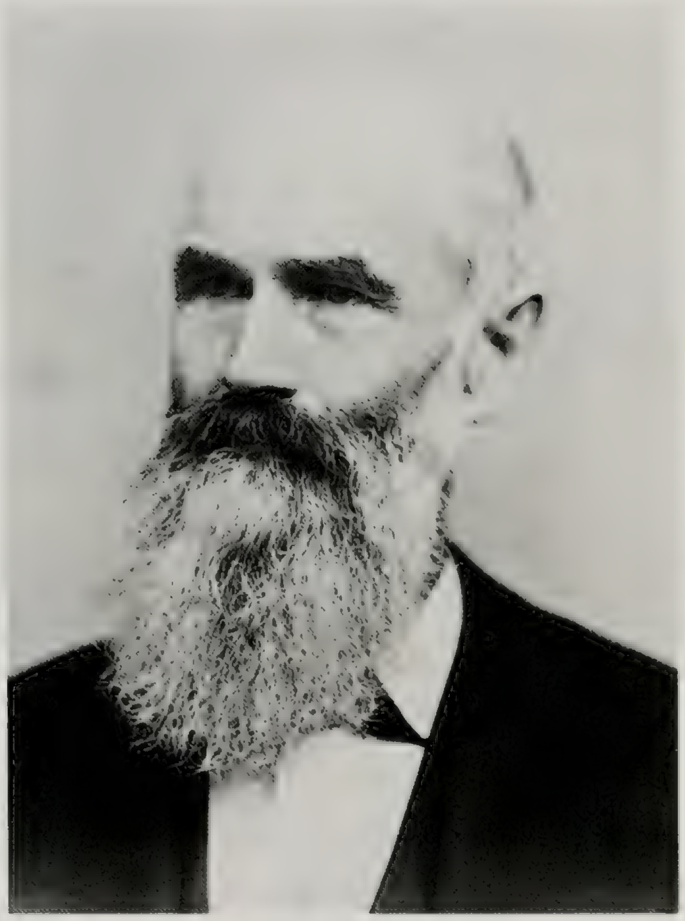
THE WORKS OF THE CREATOR

AMOS WORTHEN'S GEOLOGICAL SURVEY OF ILLINOIS

by Robert G. Hays

Like a sailor in a Rudyard Kipling poem, Amos Worthen - had he been free to choose - probably would have settled somewhere near the sea. But family connections led him instead to western Illinois, where he took up the humdrum life of a small-town merchant. If he had been good at it, the brilliant history of American science might well be dimmed by the loss of one of its brightest stars.

Amos H. Worthen was the second Illinois state geologist and, later, first curator of the State Museum of Natural History. His work had profound impact on nineteenth century science. Even today, his shadow looms large over American geology - the image of a giant intellect whose remarkable publications on the geology of Illinois became an indispensable source for paleontologists all over the world.



Amos H. Worthen

Merchant to Scientist

Worthen was a Vermont native who immigrated to Illinois after working for a time as a teacher in Ohio. In 1836 he settled in Warsaw, Illinois, where his wife's family had moved earlier. And Warsaw was not without other attractions. He was fascinated by the geology of Hancock County, especially the rich beds of geodes in the bluffs near the Mississippi River. Such surroundings whetted his growing fascination with natural science.

The new Illinoisan's heart apparently never was in his dry-goods business; waiting on customers must have been tedious and boring for a man impatient to climb among the rocks and marvel at the mysteries of geologic ages. He was eager to share the things he found with others whose interests were like his own. And he preferred trading geological specimens to trading the merchandise in his little store for customers' hard-earned cash.

In the early 1840s, hard financial times forced Worthen to make a business trip back East. Before he left, he packed several barrels with geodes. He knew they were of value to mineralogists throughout the world. He wanted something he couldn't get in Hancock County, and he found it in Boston - a fine collection of seashells. He acquired them in trade for his geodes. But if the business trip saved his store in Warsaw for a few years longer, the seashells ruined forever any interest he might have had in being a merchant.

The shells added greatly to Amos Worthen's curiosity about the world around him. He saw similar forms fossilized in the limestone of Hancock County. He was intriqued. How did they get there, so far from the sea? He spent every spare hour, hammer in hand and satchel over his shoulder, clambering over bluffs and ravines, exploring every rock surface he could reach.

Through vigorous exchange with other collectors around the country, he accumulated an extensive collection of specimens. He also gained an impressive library of books and other scientific publications, using funds that might have gone more profitably into his sagging business. He kept up a vigorous correspondence with a number of persons with similar interests, including some of the best known figures in the academic world. When the American Association for the Advancement of Science held its annual meeting in Cincinnati in 1851, Worthen was elected to membership. But the endless hours spent studying his rocks and seashells had taken their toll on his business. A few months later, Worthen sold his declining enterprise and gave himself over entirely to science. His timing probably could not have been better.

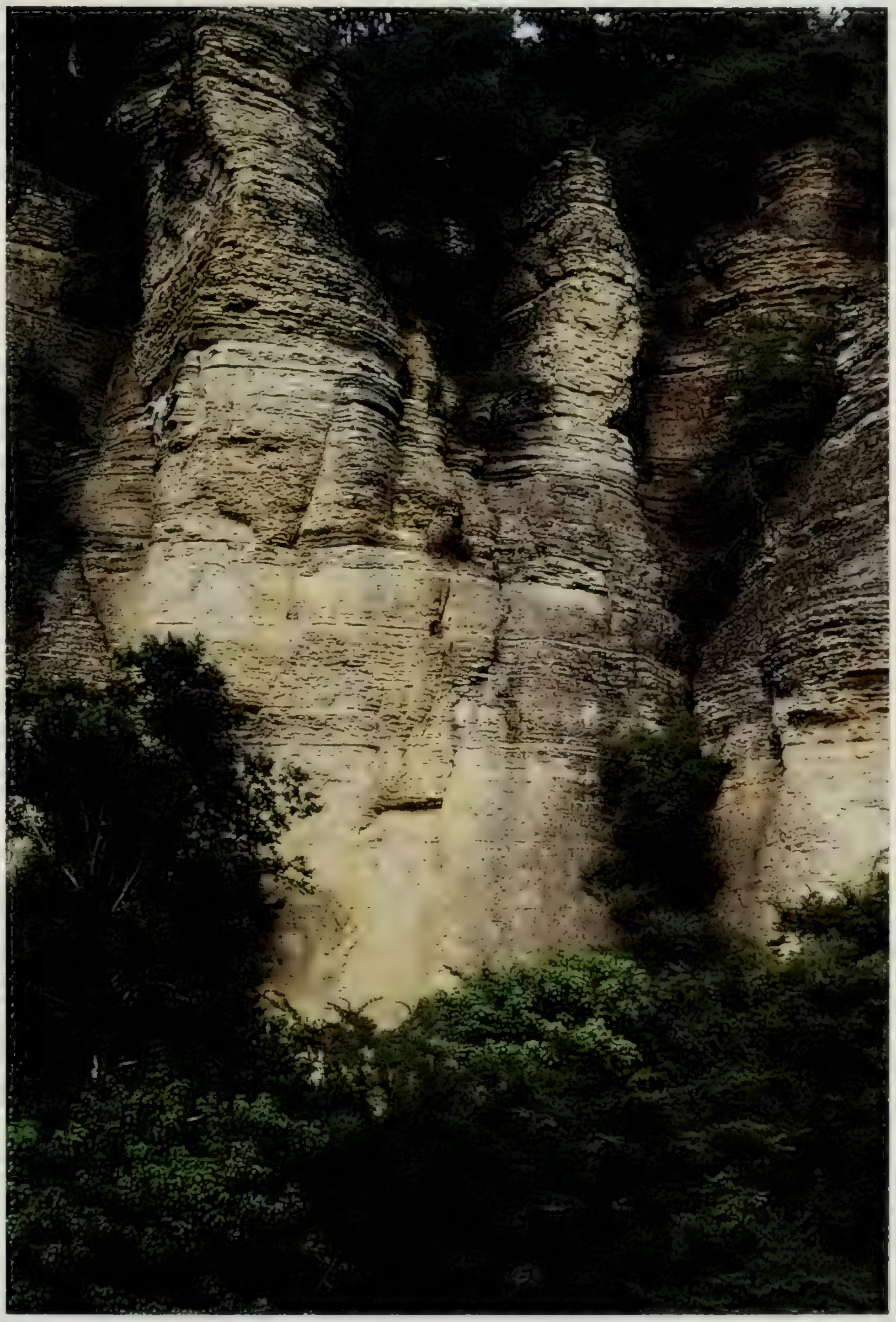
Economic Geology

Illinois' geology had been subjected to limited study. Dr. J. G. Norwood, whose interests had led him to leave medicine in favor of geology, had just been named the first Illinois state geologist. Dr. Norwood had worked with David Dale Owen, a European-trained geologist whose father, Robert Owen, was the leader of the utopian community of New Harmony, Indiana. The younger Owen had received a U.S. government mandate to study the lead region of northern Illinois, Wisconsin and Iowa in 1839. That hastily organized survey, though somewhat meager, was the best effort to study the geology of Illinois until Dr. Norwood's appointment in 1851. Amos Worthen worked for a time as Dr. Norwood's assistant, then joined a team of scientists carrying out a similar study in Iowa.

Dr. Norwood's performance never fully pleased members of the Illinois legislature, who must have agreed to fund his work in hopes that he would discover a wealth of valuable minerals. Dr. Norwood vigorously pursued the collection of specimens representative of the state's geological formations. The legislature clearly wanted a more "practical" survey, and Dr. Norwood was fired. Amos Worthen was named to succeed him.

Worthen had no formal training in geology, itself still a young discipline. But through self-study, collecting and exchanges with other scientists, he had gained a good understanding of the way sedimentary rocks were formed and how the remains of plants and animals were fossilized in these rocks. It was this special area of geology - paleontology - that most intrigued him, and he was content to hire other well-qualified specialists to round out his geological survey staff.

Like Dr. Norwood before him, Worthen began his survey with a study of southern Illinois. Dr. Norwood initially had undertaken an examination of the limestone cliffs along the Ohio River between Shawneetown and Cairo. Worthen began with a cross-section study near the southern end of the state, then moved to points along the Mississippi River for more detailed observations. He then set a team of geologists to work in the northern lead district and the known coal regions, and eventually began a county-by-county survey.



Pine Hills limestone bluffs in Union County (Courtesy: John Taft, INHS)

Worthen understood the importance of "economic geology." In Volume I of his published *Geological Survey of Illinois*, appearing in 1866, he set forth the objectives of his work: "First, to determine the location and extent of whatever natural resources the state may possess...and second, to prevent the unnecessary expenditure of money and labor in searching after valuable minerals in those portions of the State where such minerals do not exist." He was determined to do much more. His was a gigantic undertaking, one that occupied him and a group of carefully selected assistants for more than a decade.

The Illinois General Assembly continued to support active geological field work until 1872. Then regular appropriations were discontinued. Four massive volumes of the *Geological Survey of Illinois* had been published by this time and additional volumes were in preparation. Small supplemental funds were appropriated until 1875, when all provision for the geological survey of Illinois ended.

Two years later, the State Museum of Natural History was established in Springfield with Worthen as curator. He spent the next decade studying his fossil collections and preparing the remaining volumes of the geological survey reports for publication. The eighth and final volume, unfinished when death overtook him in 1888 at age 74, was left to be completed by his successor, Joshua Lindahl. It was finally published in 1890. There would be no state agency specifically charged with coordinating geological research in Illinois until the modern Illinois State Geological Survey was established in 1905.

Appreciated Elsewhere

Given the extent of Worthen's success to that point, why did the Illinois legislature allow the geological survey to languish and, finally, to die? The most obvious reason is that, from the legislators' point of view, the work appeared to be finished. Few American legislators in the nineteenth century understood or appreciated the concept of a state geological survey as a continuing institution. By 1872 Worthen had completed a geological catalog of the state, county by county. He had found no gold or other precious metals. Illinois was primarily an agricultural state. Rock formations, for the most part underground, seemed of little importance in comparison with the rich prairie soil. The value of coal was not yet fully appreciated, nor had the value of oil for fuel or stone for building fully materialized. Further investigations of the geology of the state probably seemed futile to most residents. Fossils might be interesting, but their study hardly merited the expenditure of taxpayers' money.

Amos Worthen, very much aware that laymen would have difficulty comprehending the significance of his pioneering work in paleontology, had made every effort to justify its value. Imbedded organic remains (plant and animal fossils), he explained, provided the geologist with a guide to the period in which a stratum of rock was formed - a kind of roadmap to potential mineral deposits.

Coal and other valuable minerals, which his survey was seeking to locate, were not just indiscriminately distributed through the earth but were deposited during particular geologic periods. Therefore, a careful and thorough investigation of the organic deposits to be found in the state was the first step in the prosecution of a thorough geological survey. "Indeed," Worthen noted in the second volume of his reports, "without the aid of Palaeontology, Geology would scarcely be entitled to rank as a science at all."

Worthen was astute enough to recognize that scientific activities like his geological survey could hope to succeed only so long as they enjoyed some level of public support. He appealed to state pride. The rocks of Illinois, he wrote, were unusually rich in fossils. He expressed confidence that Illinois citizens "will feel a commendable pride in contributing their share to the general knowledge, in a department of science now claiming so much attention from enlightened minds throughout the civilized world." And he stated his desire that students in Illinois colleges and universities have ample supplies of geological specimens - those "wonderful works of the Creator, so profusely scattered at our feet."

Crinoid fossil grouping

But whatever compromises to "practical" science he had been willing to make in the interest of public support, Amos Worthen was determined that his contributions in paleontology should be valued beyond mere utilitarian considerations. It never ceased to amaze him that the fossilized remains of fishes and seashells were found in such numbers so far inland, proof that in some age in the distant past the region had been covered by water. There was so much in the history of "these mute relics of by-gone ages," he insisted, that they should be of profound interest to all reflecting minds.

The failure of the legislature to understand all this left Worthen somewhat bitter. In a letter to Governor John L. Beveridge in 1875, transmitting Volume VI of the *Geological Survey of Illinois*, he stressed once again that he had always kept in view the dual considerations of economic benefit to the state and the search for scientific knowledge, in that order.

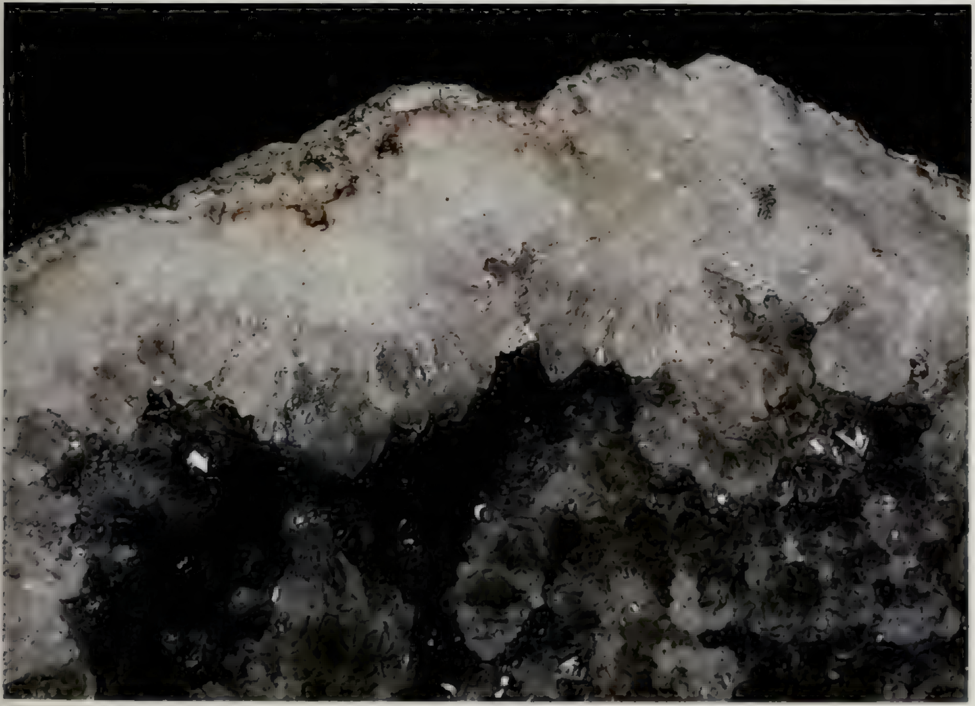
His contributions to geological science probably never would be fully appreciated by the people of Illinois, he wrote, but "I have the satisfaction of knowing that they are (appreciated) elsewhere, and that the *Illinois Reports* are esteemed a desirable acquisition to all scientific libraries." He went on to outline the financial limitations under which he had been forced to conduct his survey, lest anyone might suppose "there has been an unnecessary expenditure of money in the prosecution of this work."

Indispensable

Even today, it is difficult to characterize justly the magnitude of Amos Worthen's accomplishment. The eight massive volumes of his *Geological Survey of Illinois* embraced both the structural (surface and stratigraphic) and economic geology of the entire state - 56,000 square miles. They included individual reports on the geology of each of the state's 102 counties. The productive coal field of more than 37,000 square miles was mapped in considerable detail, as were regions where lead and other minerals were to be found. General geological principles were treated at length, along with topical subjects such as the origin and formation of the prairies.

But the most important portion of his monumental series was in the area of paleontology - ironically, as Worthen himself had noted, the part of his work least likely to be appreciated by the people of his own state. Charles A. White of the U.S. Geological Survey, a contemporary of Worthen's, described that part of the series as "so extensive and so elaborate that the volumes of the Illinois survey have long been indispensable to every palaeontologist in every part of the world where the Palaeozoic formations are studied."

The sheer size of Worthen's achievement is indicated by the fact that his reports described and illustrated nearly 300 species of vertebrate animals and more than 1,000 invertebrates identified among fossils found in Illinois. There were, in addition, 256 species of ancient plants. And as White pointed out, nearly 1,500 of these species were first made known to the scientific world through Worthen's publications.



Close-up of geode interior

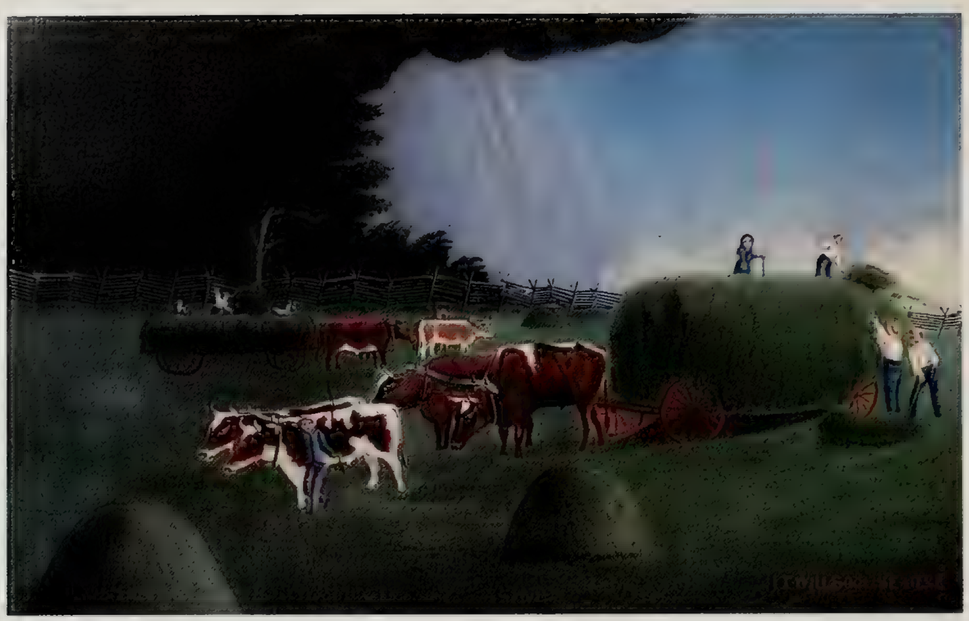
Worthen was never inclined to take a narrow view of the need for state-supported scientific activity in Illinois. His fascination with the rich variety to be found in the natural environment simply would not permit such a limited perspective. He recognized that Illinois' great north-south length resulted in a wide range of climate. This meant a variety of plant and animal life ripe for exploration by botanists and zoologists. But many plant and animal species were becoming increasingly rare, Worthen warned. With every passing year, it would become more difficult to make a complete collection of natural history specimens native to the state. He strongly favored state support for such work.

Whatever discouragement he may have felt when the legislature ceased to fund his geological survey, Worthen was confident that at some point such investigations would go forward again. New discoveries about the state's enormous coal resources were being made regularly, he advised Governor Beveridge, through experimental drilling. He was adamant that such information be made available to the public.

Throughout the later years of his life, Amos Worthen was vigorous in his defense of state-supported science. He was convinced from his experience with the geological survey that government financing of scientific activity was important not only to the advancement of scientific knowledge, but also to the economic development of Illinois.

Time, of course, would prove him right. ■

Robert G. Hays teaches communications at the University of Illinois. His book, ***State Science in Illinois*** *(Southern Illinois University Press, 1980), traces the history of the Illinois State Surveys and their forerunners from 1850 to 1978. This is the first in a series of articles on the history of the Illinois Scientific Surveys*



Jannsonite Painter Olof Krans' "It Will Soon Be Here"

(continued from p. 3)

Survey reports that the area was aesthetically pleasing and that there was an interspersion of prairies and forests along the South Edwards branch of the Edwards River. Along the creek a grove of red oaks met the prairie. For Olaf Olsson, the ingredients for paradise were all there: a good water supply; tillable, fertile land; a wood supply for building; and a stream for turning a saw mill and a grain mill. And the land was available for $1.25 an acre. His reports back to Sweden encouraged the Jannsonites to immigrate.

Over the next three years, 1,100 disciples crossed the Atlantic, the wealthier members of the sect paying the passages of the poorer Jannsonites. This initial pooling of community wealth became one of the founding principles of the Jannsonite community in Illinois. Like the early Christian church, the Jannsonites would be communalist, at least during the formative years of the colony.

The voyage from Sweden was fraught with peril. Nearly a dozen ships carried Jannsonites to Bishop Hill, the trip lasting anywhere from three to six months. One schooner, the *Betty Catharina*, left port on August 8, 1846, with 60 Bishop Hill passengers on board and a cargo bay full of iron ore. It never reached America. High winds and heavy seas caused the cargo to shift, capsizing the ship and sending its unfortunate passengers to a watery grave. Another ship, the *Wilhelmina*, set sail with 119 passengers, many of whom were women and children. Three children were born on the voyage across the Atlantic, but 21 children died before the ship reached New York.

The Swedish settlers arrived in New York speaking no English. They traveled by steamer to Albany, passed through the Erie Canal to Buffalo, and by steamer through the Great Lakes to Chicago. From there, all but the weakest walked the 100 miles to the banks of South Edwards Creek on the southeast quarter of section 14 in Weller Township. They named the site Bishop Hill, after the Swedish birthplace of their leader.

Prophet and Loss

That first year in Illinois the Jannsonites endured great hardship. Arriving in the fall, colonists had little time to prepare for winter. Makeshift shelters were constructed and burrows were dug into the side of a hill. Of the original 1,100 immigrants, 350 died that first winter or deserted the sect once their passage to freedom had been paid. Nearly all of the colonists' funds were consumed in the passage over, and the Jansonnites could afford to buy only 40 acres of land.

But by 1849 the colony had constructed a splendid church and four-story dormitory and dining hall, all built from brick molded and fired by colonists on the site.

Tragedy struck the settlers again that year. The cholera epidemic, which would continue to ravage the Midwest until 1854, came to Bishop Hill. Before it left, 200 more lives were lost, including Jannson's wife and children. The surviving colonists numbered fewer than 400.

Things were improving by 1850 and Bishop Hill showed signs of prosperity. The colonists owned 4,000 acres of land, a steam-run flour mill and a grist mill. The Jannsonites had also earned a reputation for their excellent breeds of cattle, the direct result of the colony's trade with the Shakers of Pleasant Hill, Kentucky. The Shakers, another communal religious utopian sect with 19 villages from Maine to Kentucky, also taught the Jannsonites how to cultivate broom corn, grow fruit trees and other useful horticultural skills.

That year death again visited the colony. Jannson, the colony's charismatic leader, was murdered in nearby Cambridge, the result of an ongoing marital dispute between Jannson's cousin Sophie, and her estranged husband, a non-believer named John Root. Despite the loss of their spiritual leader, the Jannsonites endured and continued to build their utopia on the prairie.

In 1853 the colony incorporated under the laws of Illinois and experienced several years of growth. By 1856 Bishop Hill could boast a $36,000 annual profit from the sale of its broom corn alone. There was, however, considerable debt. Although the colonists' assets in 1859 included 10,000 fenced-in acres worth an estimated $300,000, they owed nearly $100,000. In 1860, the Bishop Hill utopian experiment came to a frustrated end. When the Civil War broke out in 1861, the colony's able-bodied young men were organized into a regiment and marched off to war, leaving the community's older residents behind to watch paradise fall into decay. ■

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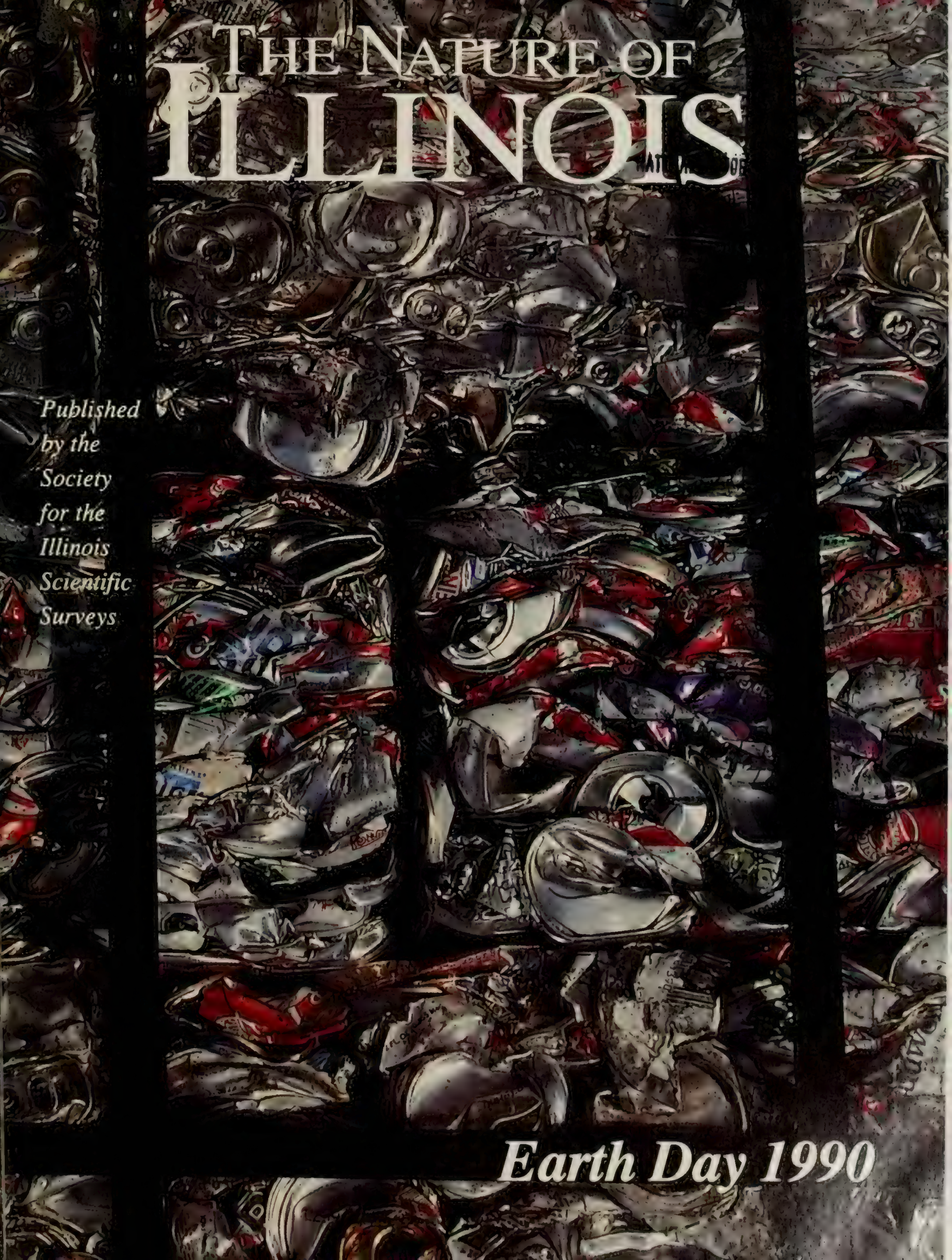

Earth Day 1990

THE NATURE OF ILLINOIS

Earth Day 1990

AUG 26TH 1818

Dear Illinois Citizens:

Welcome to this special Earth Day Illinois 1990 commemorative issue of **The Nature of Illinois**, which marks the 20th anniversary of the first Earth Day celebration. More importantly, it kicks off a new decade of environmental awareness and action as we approach the 21st century. Nearly a dozen state agencies and numerous environmental groups are planning special events such as exhibits, fairs, seminars and field trips to promote environmental issues.

Illinois citizens are genuinely interested in the environment. One of the issues currently at the forefront and likely to be around for a long time is solid waste management. Unlike some environmental issues, garbage is something that we, as individuals, can do something about. By participating in community recycling, yard waste composting programs and making wise purchasing decisions, we can reduce our dependence on landfills and incinerators. Therefore, we can reduce the amount of waste generated in the first place.

I hope you will read and save this issue. Remove the insert and use it as a constant reminder of what you can do everyday to help the environment. I encourage all individuals and groups to become involved in community Earth Day events. Each person can make a difference. Nature is counting on you.

Sincerely,

James R. Thompson
Governor

Printed on recycled paper

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About the Cover

Baled drink cans awaiting recycling.

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Editorial Staff
Jane A. Bolin *Editor*
Michael Jeffords *Photographer*

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Stay In Touch

Name, address or delivery changes, membership or contribution inquirires, letters to the Editor, should be addressed to The Society for the Illinois Scientific Surveys, 319 W. Cook St.., Springfield, IL 62704, (217) 522-2033.
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NATURAL HISTORY SURVEY
AUG 16 1990
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A Message From The Chairman Of The Society

As a child living in Lake Forest, I was brought up on the edge of a big prairie. The public school I went to had no athletic programs, and so much of my recreational time was spent tramping around the marsh. One of the highlights of my childhood was trout fishing in Wisconsin with a friend of my father. For several summers I worked as a ranch hand in Wyoming. My love of the outdoors and open spaces has carried through my whole life. As a child I took these natural riches for granted, assumed they would always be there.

We certainly didn't worry about air pollution. One of the great attractions of my grandmother's Chicago home was the railroad bridge at 47th Street, where my brother and I would hang over the side breathing in deeply the coal-fired fumes of the trains passing below. We thought it great fun.

In 1932 I started working in Chicago as a printer. It was obvious even to my untutored lungs that the air was better in the country. I liked the city, but I always knew I could escape to my father's home in the country, the country then of course being Lake Forest. We used to fish off the pier there and come up with some great perch catches. When fishing was slow, we swam in Lake Michigan. We assumed that the lake's waters were clean, never worried about it. We didn't worry about garbage either. Someone came along and picked it up and that was the end of it.

I started duck hunting with my friends in the fall of 1933 and every year after that near Hennepin on the Illinois River. But things were changing, and not for the better. The fishing was off because of the pollution from Chicago. They cleaned that up, but sediment began to build up in the river, the ponds and the bottomlands, filling in the backwaters and killing off vegetation and waterfowl habitat. There was much less wildlife, fewer open spaces around the city, and the suburbs were spreading out.

What I had enjoyed as a child I now saw would not last forever. I became a Chicago sponsor for the National Recreational Association in 1935. The Association's mission was to promote recreation - especially outdoor recreation - for inner city residents as well as suburbanites. After World War Two, I became chairman of the National Recreation Association's Chicago Committee. I believed, and still do, that the need for people to be connected to the outdoors, to what we now call the "environment", is as fundamental as breathing.

It was in the 1950s that I became involved with the Illinois Natural History Survey through Dr. Glen Sanderson's efforts to save the prairie chicken from extinction. The Prairie Grouse Committee of the Nature Conservancy raised sufficient funds to establish official sanctuaries for the prairie chicken in Jasper and Marion counties.

So much of what I had taken as a matter of course, as second nature if you will, was now disappearing. I expanded my efforts on behalf of the natural riches of Illinois. We need the work of groups like the Natural History, Water and Geological Surveys to research and protect our natural resources. They are not finite. They will not sustain themselves unless each one of us takes a hand, whether it is recycling our garbage or becoming a participant in the many volunteer efforts to clean the environment.

What is good for nature is good for humankind. If we preserve and restore our wetlands, for example, we can help control flooding, reduce pollution and provide for wildlife habitat. It's a natural thing to do.

This special Earth Day issue of **The Nature of Illinois**, with an emphasis on solid waste management and recycling, is a joint effort of the Society and the Illinois Department of Energy and Natural Resources. We hope that it will prompt all of us to reflect on what we have done *to* - and what we can do *for* - our planet.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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TAKING OUT THE TRASH

by Bill Kemp

"Nobody wants to live next to a landfill, or a transfer station, or an incinerator. Well, how about if we passed a law that said, 'O.K., folks, you don't have to. We've got it all taken care of. From now on everybody buries his garbage in his own backyard.' How long would we get away with that? But how long are we going to get away with opening the kitchen door; putting out the garbage; opening the kitchen door the next morning; seeing the garbage is gone; and saying: 'Isn't that terrific.' "

Governor James R. Thompson
State of the State Address
January 10, 1990

Scrap metal shredder, Chicago

Governor Thompson signed the Illinois Solid Waste Management Act three-and-a-half years ago, but that was just the first step in an extended process to address the multi-faceted problems of solid waste in Illinois. In his State of the State speech this year, the Governor said that the shrinking availability of landfill space is one of the state's most pressing problems. The 1986 act and a flurry of legislative activity during the last two sessions of the General Assembly have made important inroads into addressing solid waste management.

Illinoisans are now recycling more glass, paper, metal, and even plastic materials than ever before. County government officials now realize that the "out of sight, out of mind" attitude toward solid waste is no longer viable. Illinois' 102 counties are in the process of drafting plans to manage solid waste more effectively. Progress is being made, but as Thompson said to the state on January 10, much more needs to be done.

The Cold, Hard Facts

Each Illinoisan churns out a startling five pounds of garbage every day, roughly twice the amount a European or Japanese citizen produces. Each year Americans dispose of approximately 50 million tons of paper, 28 million tons of yard waste, 12 million tons of glass, and 10 million tons of plastic. Most of these discarded materials are recyclable. The Illinois Environmental Protection Agency (IEPA) estimates that more than 46 million cubic yards of garbage are disposed of in Illinois landfills each year. The agency estimates that of the total amount of solid waste generated in Illinois, 92 percent is eventually sent to landfills, two percent is incinerated, and only six percent is recycled.

Forty percent of municipal solid waste is residential in nature, and the remaining 60 percent originates from commercial and industrial sources. Roughly 37 percent of the solid waste stream, by weight, is paper and paper products. Eighteen percent of the waste comes from yard waste products like grass clippings and leaves. Metal and glass products make up approximately 18 percent, food waste and plastics another 16 percent, and wood, textiles, and rubber products comprise the remaining 10 percent.

In the past, Americans were content with an "out of sight, out of mind" solid waste philosophy. But with landfill space rapidly shrinking in Illinois and elsewhere, people are beginning to realize that throwing the one-liter polyethylene terephthalate (PET) soda bottle into the trash has local, as well as state, national, and global implications. Like the rest of the nation, Illinois is running out of places to stash its trash.

The Illinois Environmental Protection Agency estimates that, given current disposal trends, statewide landfill capacity could be depleted by the late 1990s. The northeast region of the state and the Chicago metropolitan area face the most immediate landfill shortages. In short, Illinois has historically been over-dependent upon landfills, a practice that must change.

The Five-Point Hierarchy

The cornerstone of the state's solid waste program remains the Solid Waste Management Act. Although there have been significant pieces of legislation since, the 1986 act laid a philosophical and policy groundwork for a battle plan to address the state's growing solid waste problems. The purpose of the act was to reduce reliance on landfills, and to encourage alternative means of solid waste management like recycling. The act established as state policy a "waste management hierarchy" of ideal steps to reduce waste. The five approaches to handling waste, in descending order of preference, are:

- Volume reduction of waste at the source
- Recycling and reuse
- Incineration with energy recovery
- Incineration for volume reduction
- Disposal in a landfill

According to the act, hauling solid waste to a landfill should only be considered if all other avenues have been exhausted. Landfills should be a measure of last resort.

The state would like to see Illinoisans reduce their reliance upon such items as the eight-ounce cardboard and plastic juice packets that are popular today. These juice containers are not easily recyclable, so alternative products should be bought in order to reduce the volume of waste at the source. Fancy and unnecessary packaging of consumer goods should be avoided.

Second, all recyclable products should be recycled. Nothing should be pitched into the trash can if it can be recycled or reused. Recycling programs today are more than just newspapers and aluminum cans. Many plastic products, batteries, and motor oil, among other frequently used household goods, are recyclable.

Third, the state would like to see Illinoisans' remaining trash converted into energy at an incinerator, combusted, or composted to reduce garbage volume.

Finally, if all else fails, the remaining trash would be landfilled.

Source Reduction

The idealized hierarchy of the Solid Waste Act remains largely a goal, not a reality. Witness the fact that an estimated 92 percent of the state's solid waste is still placed in landfills. Overall waste reduction has not yet occurred, although more products than ever before are being recycled. Simply put, Illinoisans are generating approximately the same amount of solid waste today that they were generating ten years ago, if not slightly more. If individual and business habits cannot be modified, even great strides in recycling will not be enough to reduce the strain on the state's landfills.

"Without a substantial reduction in the waste stream, all our efforts at management will fail, and facilities for disposal will be overwhelmed," says Tim Warren, a solid waste expert at the Illinois Department of Energy and Natural Resources (ENR). A Waste Reduction Task Force comprised of representatives from state and local governments, waste haulers, environmental advocacy groups, and community recyclers is scheduled to present its findings this spring.

One of the most innovative programs in the state aimed at reducing waste at the source is occurring in the Champaign-Urbana area. Central States Education Center has created a model community program that includes a waste hauler who gives discounts to households that cut waste to one trash can a week.

"Financial incentives are a key to reducing waste," says John Thompson,

Christmas trees waiting for processing

Executive Director of Central States. Thompson says opening more landfills is akin to a doctor prescribing bigger pants for an individual with a weight problem. "The state needs to put the patient on a diet," he says in calling for more state resources aimed at waste reduction at the source. In addition to discounts, the Champaign-Urbana program includes an advanced labeling initiative at two local grocery stores. One environmentally acceptable category is "least waste packaging," which allows the consumer to choose products that will generate the least waste.

Recycling

Most state activity has concentrated on the recycling aspect of the solid waste management equation (see *Waste Not, Want Not*, this issue, page 9). The Department of Energy and Natural Resources has awarded approximately five million dollars in grants and loans to fund community curbside recycling programs, buy-back centers, and most recently, municipal composting programs. State grants are financed through a fund created by the 1986 Solid Waste Management Act. "Tipping" fees are charged by landfills for disposal of solid waste. David Buckner, ENR's Deputy Director, says that because of the grant program, an estimated 400,000 Illinois households can participate in curbside recycling programs today. Buckner says that in 1986, a mere 20,000 households participated in such programs.

The department has helped finance 70 curbside programs, 20 drop-off facilities and 26 composting programs. XL Disposal, based in south suburban Crestwood, for example, received a $500,000 loan from ENR to install state-of-the-art automated recycling equipment. The facility, which uses magnetic and pneumatic separators to divide recycled materials, processes 400 tons of solid waste a day from five suburbs and parts of Chicago.

Ironically, the state's success in opening many community recycling programs has drawn criticism from some who believe ENR has devoted too much money to the collection of newsprint, glass, and aluminum, and not enough money to the task of creating markets and alternative uses for recycled products. A glut of newsprint and a lack of markets for recycled newsprint continues to depress the recycling industry.

Karen Witter, ENR's Director, says that Illinois' industrial base has the potential to absorb recycled materials, but acknowledges that "much of that potential remains untapped." For newsprint, the necessary ingredient currently missing in the recycling loop is that newspapers must use more recycled newsprint.

Nationally only 3.5 million tons of the 13.6 million tons of newspapers printed in 1988 were recycled. And of the 3.5 million tons recycled, less than 1.5 million tons were recycled again. Connecticut passed a law in 1988 mandating that newspapers with a circulation greater than 40,000 use 40 percent recycled fiber in at least 20 percent of the newspapers' sheets by 1993. California imposed legislation requiring up to 50 percent recycled content in all of the two million tons of newsprint consumed annually in the state. Similar legislation appears unlikely in Illinois. The Illinois Press Association recently organized a Newsprint Recycling Task Force that is expected to recommend voluntary standards for Illinois newspapers, according to Beth Philips, a lobbyist for the association.

Biodegradable bags of leaves in a compost pile

Incineration

The goal of incinerating more solid waste, either for energy conversion or simply to reduce the volume of trash heading to landfills, has made little progress. According to Tim Warren, stringent state environmental controls make building and operating an incinerator a costly proposition in Illinois. In addition, because of the availability of relatively cheap energy, a garbage-to-energy facility is not yet economically feasible.

Warren says if tipping fees in the Chicago area continue to rise, incinerators might become a popular alternative to landfills for some communities. Already, several economically depressed Chicago south suburban communities are making plans to build either privately or publicly owned incinerators.

An Unfinished Job

The Solid Waste Management Act of 1986 laid a strong foundation for subsequent legislation; and Illinois, most notably in the area of recycling, has made significant progress in four years. In 1987 two percent of the state's garbage was recycled. Today that figure has increased to six percent. Progress, yes, but much more needs to be done. The monumental problems associated with the question of "What do we do with our garbage?" still plague our state. ■

DOWN TO EARTH IN ILLINOIS

by Susan Post and Michael Jeffords

Showy lady's slippers

A commonly held misconception about Illinois is that it contains corn, soybeans and Chicago, and that it is a state traveled through to get somewhere else. Historical accounts of Illinois speak of huge trees, vast grasslands and extensive wetlands. Unfortunately, these impressive landscapes rapidly became timber leases, farmsteads and urban sprawl, and the organisms that inhabited them were left to survive in isolated remnants. Nevertheless, woods, wetlands and prairies can still be found, often in "miniature" and preserved by law or by individuals who cared enough to save these fragile habitats for future generations.

Red-winged blackbird nest in compass plant

Great horned owl

Cardinal flower

Dew-covered spider web

View of Mississippi River from the Pallisades. Illinois is a water-rich state, almost completely surrounded by four bodies of water.

Stephen Forbes, the founder and first Chief of the Illinois Natural History Survey, understood the importance of enjoying the resources of the state. In 1891 he wrote, "The children must be drawn towards and not away from the woods and fields and waters and must be led to see more clearly that...a man cut off from fellowship with the creatures of the open air is like a tree deprived of all its lateral roots and trimmed to a single branch. He may grow down and up, but he cannot grow out. His resources of enjoyment are so narrowed that he is often an object of pity when seen away from the city street."

Because only a few patches of wilderness remain, they are often overlooked. Much of the natural beauty of Illinois escapes our notice because we have formed the habit of looking only at broad outlines and ignoring fine detail. To overlook the details is to becomes Forbes' "object of pity." These fragments of Illinois are part of our heritage - as important as art, language and culture. They possess a soundless explosion of life that is ours to treasure. The Society hopes you enjoy this pictorial guide to Illinois' explosion of life on this Earth Day--and beyond. ■

The opossum, Illinois' only marsupial, has adapted well to living with humans. Other species have not been so fortunate.

Illinois leads the nation in the value of crops exported.

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THE NATURE OF
ILLINOIS

NATURAL HISTORY SURVEY
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WHAT HAVE YOU DONE FOR YOUR PLANET TODAY?

101 Ways You Can Improve the Environment

Every American, every Illinoisan, can take steps to improve the environment. We hope you will keep this Guide in some handy place as a reminder of how you can change the world.

IN THE HOME

The United States makes up only five percent of the world's population, yet we use one-third of the total amount of energy produced in the world each year. Nearly 50 million tons of carbon are emitted into the air each year in Illinois through the burning of fossil fuels such as coal, oil and natural gas. Much of this energy is used unnecessarily, and energy use within the home is one major contributor to this waste and potential pollution.

PURCHASING TIPS

1. **If you're purchasing a home, check its energy efficiency.**
   Get an energy audit and examine past heating bills.
2. **Buy energy-efficient appliances.**
   Compare Energy Guide Labels on various models.

HEATING AND COOLING TIPS

3. **Ask your utility company for a home improvement survey.**
4. **Obtain home energy conservation information.**
   Your regional Government Printing Office and local environmental organizations are good sources.

earth day
Illinois
1990

5. **Insulate your home.**
   An estimated 20 to 30 percent of the load on heating and cooling systems can be reduced by good insulation.
6. **Caulk and weatherstrip your doors and windows.**
   This can save the average home up to 10 percent annually on energy costs.
7. **Install storm windows and double-paned windows.**
8. **Close off all unused areas in your home**
9. **Unless you have a fire going, keep your fireplace damper closed.**
   An open damper can let up to eight percent of your home's heat escape through the chimney.
10. **Use a clock thermostat for heating and air conditioning units.**
11. **Wear warmer clothing in cooler temperatures.**
12. **Keep the windows near the thermostat tightly closed.**
13. **Keep your water heater at 120 degrees.**

LIGHTING

14. **Substitute compact flourescent lighting for traditional bulbs whenever possible.**
    This reduces the amount of carbon dioxide in the atmosphere.
15. **Turn off lights in any room you aren't using.**
16. **Reduce overall lighting.**
    Replace existing bulbs with lesser-wattage bulbs and remove one bulb from multi-bulb fixtures. (Remember to replace bulb with non-working bulb for safety.)
17. **Clean all lamps and lighting fixtures regularly.**
    Dust and dirt absorb light, making fixtures less efficient.
18. **Use outdoor lights only when necessary.**

Printed on recycled paper

SAVING ENERGY IN THE KITCHEN

19. **Whenever possible, use cold water rather than hot water for kitchen tasks.**

    This saves the energy used in heating water.

20. **Use small electric pans or ovens for small meals.**

21. **Run your dishwasher only when it's full.**

    The average dishwasher uses about 14 gallons of hot water per load, so combine loads to avoid energy waste.

22. **Avoid keeping your refrigerator or freezer too cold.**

    The government-recommended temperature for the fresh food compartment of refrigerators is 38 degrees Fahrenheit. For the freezer, it's five degrees Fahrenheit.

SAVING ENERGY IN THE LAUNDRY

23. **Fill your washer, but don't overload.**

    Combining loads saves on electricity and hot water.

24. **Presoak very dirty laundry.**

    This helps prevent having to wash things twice.

25. **Don't use excessive amounts of detergent.**

    Too much detergent makes your washer work harder and consume more energy.

26. **Run a full load in the dryer, but air-dry your laundry when possible.**

27. **Keep the lint screen in your dryer free.**

    A clogged lint screen stops the flow of air in the dryer and makes it consume more energy.

28. **Use the automatic dry cycle of your dryer.**

    Use this cycle to avoid over-drying.

29. **Instead of ironing, hang your clothes in the bathroom while you're bathing or showering.**

    This saves on electricity.

BATHROOM ENERGY SAVINGS

30. **Instead of baths, take showers of five minutes or less.**

    It takes about 30 gallons of water to fill the average tub. A five-minute shower - with a 3-gallon-a-minute flow - uses only about 15 gallons. Over a year, this can save thousands of gallons of hot water.

31. **Install a flow control device in the showerhead.**

RECYCLING

About 14 million tons of garbage are produced in Illinois each year. More than 90 percent of it ends up in our landfills. Ten years ago Illinois had 600 active landfills. Today only 132 remain. The Illinois Environmental Protection Agency estimates that, given current disposal trends, statewide landfill capacity could be depleted by the late 1990s, and even earlier for large metropolitan areas. The average Illinoisan churns out an average of four to five pounds of garbage each day. You can make a difference!

32. **Contact your local community recycling center and start separating recyclable waste into appropriate categories.**

    Separate waste material into five basic groups: newspaper, other paper, glass, aluminum and organic wastes.

33. **Contact local officials and urge them to begin curbside pickup of separated recyclable waste and household toxic materials. Participate.**

    The easier it is for people to recycle, the greater the participation. Hazardous products including paints and solvents, furniture polishes, pesticides and oven cleaners must be separated from other wastes, since they can cause serious pollution problems.

34. **Recycle all household goods, not just the obvious ones.**

    You can recycle and reuse many materials: from plastic containers to virtually all metals; from motor oil to clothing; even appliances. Your local recycling center can provide more information.

35. **Encourage family, friends, colleagues, neighbors, and local organizations to recycle and sponsor recycling efforts.**

36. **Encourage local fast food chains to modify current packaging procedures and instead opt for environmentally sound, recyclable packaging.**

    Packaging accounts for 13 percent of food costs and 50 percent of waste disposal costs.

ON THE ROAD

There are now nearly 120 million cars on the nation's roads. Each of these cars emits an average of five tons of carbon dioxide into the atmosphere each year. That means we're putting 600 million tons of carbon dioxide into the air just by driving. Scientists predict that over a period of time carbon build-up could cause global temperature changes, resulting in unusual flooding in some areas and extreme drought in others.

37. **If you're shopping for a car, buy the most fuel-efficient one you can. Aim for 35 mpg, and don't buy a bigger car than you need.**

38. **Avoid buying optional equipment.**

    Convenience options may decrease fuel economy.

39. **Properly maintain your vehicle; get it tuned up every five to ten thousand miles.**

    The average car experiences a five to eight percent fuel economy after a tune-up.

40. **Make sure your brakes are properly adjusted.**

    Dragging brakes can rob a car of fuel efficiency.

41. **Use unleaded gas.**

    Recent surveys show that about 14 percent of this country's drivers use leaded gas in vehicles requiring unleaded gas. Fuel switching adds significantly to harmful auto emissions. Don't fuel switch. Use unleaded gas.

42. **Use a high quality multi-grade oil, and change oil according to the manufacturer's recommendations.**

    This helps reduce engine friction and increase fuel efficiency.

43. **Use radial tires.**

    Radial tires generally improve fuel economy.

44. **Check tire pressure at least once a week.**

    When properly inflated, tires can save up to 10 percent on gas.

45. **Greatly reduce or eliminate the use of your air conditioner.**

    A major source of chlorofluorocarbon (CFC's) emissions in America is car air conditioners.

46. **Encourage your local auto service to install and use CFC's recycling equipment for auto air conditioner repair.**

47. **Buy a light-colored car with tinted glass if legal or use sunshades for front and back windows.**

48. **Remove unnecessary items from your car.**

    The lighter the car, the less fuel it burns.

49. **Don't speed. Drive at a moderate pace.**

    As car speed increases, so does wind resistance - a big factor in gas mileage.

50. **Drive smoothly; accelerate and slow down gradually.**

51. **Plan your trips carefully. Choosing the shortest, least-congested route will save fuel.**

52. **Avoid short trips whenever possible. Walk or use a bicycle.**

53. **Avoid city driving**

    City driving consumes twice as much fuel as highway driving.

54. **Arrange or join a car pool for commuting.**

55. **Use public transportation whenever possible.**

AT THE MARKET

What and how we buy can have a major impact on the environment. Many products are made with unnecessary energy consumption or are excessively or non-recyclably packaged.

56. **Buy recyled - or recyclable - products that are sensibly packaged.**

57. **Buy products that will last.**

    Cloth diapers, razors with replaceable blades, and glass mugs are examples of durable products.

58. **Avoid products containing chlorofluorocarbons (CFC's).**

    Some CFC products are still on the market, including aerosol dust removers and various cleaning sprays for electronic equipment.

59. Don't buy Halon fire extinguishers.

They contain ozone-depleting Halon gases. Purchase traditional types of fire extinguishers instead.

60. Avoid impulse buying. Read labels and research the products you plan to buy.

61. Rent or borrow items you don't use often. Maintain and repair the items you own to insure longer product life.

62. Reuse paper bags or bring your own tote bag when shopping.

63. When possible, use hand-operated equipment instead of motorized or electric tools to do the job.

64. Avoid foods treated with preservatives, pesticides or herbicides.

65. Shop at farmers' markets or cooperatives.

66. Encourage your market to stock locally-grown produce.

67. Combine shopping trips. Keep a list of what needs to be purchased. Buy in bulk.

68. Eat low on the food chain.

The higher on the food chain we eat, the more natural resources are used for food production.

69. Discourage your family from eating fatty or "junk" foods.

Besides a healthier diet, this will cut down on meat consumption and the use of CFC packaging.

70. Buy substitutes for household items that generate hazardous wastes - for example, use a mousetrap instead of a rodenticide.

TREE PLANTING

Trees are the primary absorbers of carbon dioxide. In fact they are 10 to 20 percent more effective in absorbing carbon dioxide than crop or pasture land. Long revered as a symbol of life, the tree is now emerging as key to environmental improvement.

71. Plant shade trees next to your home.

They help cut down on air conditioning and provide windbreaks, enabling savings on heating energy consumption.

72. Landscape your lawn with trees and shrubbery.

73. Call your local environmental organization and get involved in tree-planting activities.

74. Improve schools, churches and other public areas by planting trees.

PLANTS AND ANIMALS

There are 500 plants and animals on the threatened and endangered species lists in Illinois. Destruction of habitat - loss of forests, wetlands and prairies - is the major cause of animal and plant extinction. Only seven-hundreths of one percent of Illinois' original habitat remains today.

75. Join environmental groups working to preserve native habitat.

76. "Design" a natural habitat in your own yard with native fruit and nut species and vegetative cover.

77. Buy a "living" Christmas tree.

78. Encourage major landowners to set aside "acres for wildlife."

79. Use the non-game checkoff on your state income tax return.

80. Support wetland and prairie restoration projects and reforestation.

81. Retain and restore windbreaks and stream buffers on your own property.

82. Leave water out for birds and wildlife. Use a heating device or brick in winter to keep water usable.

Make sure to change the water often to avoid mosquito infestations.

IN THE GARDEN

Planting a garden benefits both you and the environment. Vegetation of all sorts absorbs carbon dioxide, and the more home-grown vegetables you plant, the less you'll have to purchase.

83. Start a garden/try intensive gardening.

84. Grow items you'd normally buy at the store.

85. **Buy plants with vigorous leafing patterns.**

86. **Actively support organic gardening and sustainable agriculture.**

87. **Consult your garden nursery on the best native plants and on plants that require little or no watering.**

88. **Minimize use of chemical fertilizers, pesticides and herbicides.**

89. **Plant a garden instead of grass.**

90. **Start your own compost pile/mulch grass clippings into your lawn.**

Yard waste accounts for 18 percent of all materials put into landfills. As of July 1, 1990, Illinois landfills cannot accept yard waste.

WATER

Half of Illinois' 11 million citizens use surface water - lakes, streams, and rivers - and half depend on ground/well water. These vital water sources are vulnerable to many potential pollutants, including: leaking underground storage tanks, pesticides, abandoned wells, industrial wastes, leaching landfills, improperly placed septics and privies, discarded paints, solvents and other household hazardous wastes. Alongside the issue of water quality is water quantity. The average American uses 160 gallons of water each day. Help conserve and protect precious water resources.

91. **Use as little water as possible when washing your car.**

92. **Turn off water in your sinks, baths and showers when you're not using them. Repair all leaks.**

93. **Report accidental spills or illegally dumped waste to 1-800-782-7860.**

94. **If you live in an area without certified well or spring water, drink distilled or filtered water, or install faucet filters in your home.**

95. **Have a low-flush or air-assisted toilet installed.**

96. **Buy water-efficient appliances.**

97. **Reuse water from washing and other household tasks.**

98. **Collect rainwater and set houseplants outside during rainstorms.**

99. **Water lawns and gardens very early in the morning.**

100. **Use a broom rather than a hose to sweep instead of wash sidewalks.**

AT THE WORKPLACE

All of us can find ways to reduce the waste that is generated at our business or place of work.

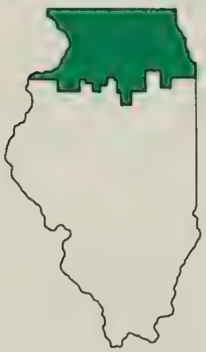
101. **For information on how industry can economically practice waste reduction and recycling, contact the Hazardous Waste Research and Information Center, Department of Energy and Natural Resources, 1 East Hazelwood Drive, Champaign, Illinois 61821, 217/333-8940.**

Two publications of interest that can be ordered from the Center are *Waste Reduction for Illinois: Information and Services* and *The EPA Manual for Waste Minimization Opportunity Assessments.*

This article excerpted from "A Citizen's Guide: The Greenhouse Crisis, 101 Ways to Save the Earth" published by the Greenhouse Crisis Foundation, 1130 Seventeenth Street, N.W., Suite 630, Washington, D.C. 20036, and from information supplied by the Illinois Department of Energy and Natural Resources. Copies of "A Citizen's Guide" can be purchased for $5 from the Greenhouse Crisis Foundation.

EARTH DAY SCHEDULE AND RESOURCES

NORTH



Chicago Earth Day '90 Project
Festival - *Lincoln Park* (4/22)

Chicago Illinois Department of Energy & Natural Resources (ENR)
Display on Household Hazardous Waste and Solid Waste Reduction - *State of Illinois Center* (4/16 -4/20)

Chicago Open Lands Project
Tree planting and "Urban Greening" (4/16-4/22)

DeKalb County Student Environmental Action Coalition
Five-day program - Speakers, discussions, letter writing, films, art, festivals, concerts (4/16-4/20)

DuPage County DuPage County Earth Day Committee
Eco-Fair, parade and nature walks - *County Fairgrounds* (4/22)

Elgin Elgin Earth Day Committee
Festival celebration. Displays, vendors, speakers and workshops - *Trout Park* (4/22)

Elmhurst Elmhurst Park District and City of Elmhurst
Tree plantings along *Salt Creek* (April-October)

Fox River Valley Fox Valley Earth Day 1990
"March for the Environment"(4/21)
Environmental Festival - *Geneva* (4/22)

Freeport Northwest Aububon Society
"Benefit for the Rain Forest" - *Highland College*(4/22)

Hoffman Estates/Palatine/Barrington
Community clean-ups (4/22)

Itasca Spring Brook Nature Center
Earth Day Festival (4/22)

Kishwaukee Kishwaukee College
Tree plantings, educational programs (4/18)
Field trips (4/21)

McHenry County McHenry County Earth Day Committee
"Forum on the Environment" - *McHenry College* (4/20)
"Education Fest" (4/21)
Major Earth Day Celebration - *Pleasant Valley Outdoor Center* (4/22)

Middle Fork
Middle Fork canoe trip (4/21)

Palatine Prairie Woods Audubon
Displays, seminars - *Rolling Meadows Library and local mall*
Tree seeding give-aways (April)
Field trips - *Twin Lakes Reservoir, Spring Valley Nature Center, and Crabtree Nature Center* (4/22)

Rockford Rock River Earth Day
Nature bus tour - *Winebago County* (4/29)
Rock River Family Celebration (4/21)
Tree planting along Mississippi, recycling event - *Rockford Discovery Center* (4/22)
Environmental Rally - *Rock Valley College* (4/22)

Rock Island Quad City Audubon Society
Clean-up - *Princeton Marsh* (4/22)
"Walk through Springtime" - *Rock Island to Blackhawk State Park* (4/22)

Rock Island Trail Friends of Rock Island Trail
hike and bike ride (4/22)

CENTRAL

Bloomington Miller Park Zoo
Earth Day Festival - *Zoo* (4/22 1-4p.m.)

Bourbonnais Bourbonnais Township Park
District Festival - *Groselin Park* (4/22)

Champaign Illinois Scientific Surveys (ENR)
Eco-Fair - Champaign Mall (4/20-4/22)
Field trips (Earth Week)

Champaign University of Illinois
Seminars on biodiversity/sustainable agriculture and other topics - Spring semester

Jacksonville Turner Jr. High School
Solid waste/composting demos (4/15-4/22)
Community celebration - *Nichols Park* (4/22)

Macomb Audubon/Western Illinois University
Environmental seminars (4/19 and 4/20)

Normal Illinois State University Earth Day Committee
Teach-ins, campus rallies, tree plantings, entertainment, speakers (4/16-4/23)

Peoria Wildlife Prairie Park
Natural Resource Celebration (4/22)

Quincy Earth Day 1990 & Beyond
Environmental Fair - *Mormon Park* (4/22)

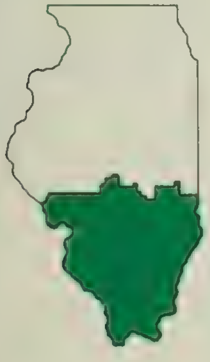
Springfield 12 State Agencies, Central Illinois Earth Week Committee, Illinois Environmental Council, Midwest Universities for Earth Day
Natural Resource Celebration - *State Capitol Complex* (4/22 10:30a.m.-7p.m.)

5K Run - State Journal Register Newspaper (4/22)

Springfield Illinois State Museum (ENR)
"Ethics of the Land Exhibit" (thru 4/15)
Family Camp-in (4/21)
Educational activities (4/22)

Wapella 4H Clubs
Recycling - *Wapella High School* (4/21-a.m.)

SOUTH



Belleville Belleville Earth Day Committee
Recycling project - *Belleville College* (4/15-4/22)
Tree planting (March-April)
Community clean-up (4/21)

Carbondale Clean and Green
Community clean-up (4/21)

Carbondale League of Women Voters/Jackson County
Energy-efficient Home Tours, recycling and composting demos. (4/22)

Carbondale Southern Illinois/Shawnee Earth Day Committee.
Eco-Fair - *Turley Park* (4/22)
Bike-a-thon - *Southern Illinois University*
Tree distribution (4/22)

Centralia Centralia Clean & Green
Tree planting (4/15 and beyond)
Recycling and "Adopt-A-Spot" (4/22-4/27)

Dixon Springs University of Illinois Forest Resource Center
Field trips, tree planting (4/22 and 4/27)
Workshops for school groups (4/23-4/26)

Granite City Tri-City Chamber of Commerce
Poster contest/community clean-up (4/21)

Madison County Southwestern Illinois Earth Day
Tree plantings, speakers and films - *Southern Illinois University* (4/15-4/22)
"Fellowship Meal" (4/18)
"CROP Hunger Walk" (4/22)
Environmental Fair (4/23)

Newton
Tree planting - *Fairgrounds* (4/15-4/22)

Staunton
Environmental Logo Contest for Schools
Sunrise service/nature walk (4/22)

STATEWIDE

Illinois Department of Conservation

Massive tree planting - 11.5 million by end of decade.

Distribution of 164,000 tree seedlings to all 3rd graders.

"Kids for Conservation" (KFC) will distribute 80-100,000 tree seedlings.

KFC will sponsor 50 membership events around state (4/15-4/22)

Illinois Department of Energy & Natural Resources

Programs and promotion of recycling and waste reduction. School programs through ILEED (Illinois Energy Education Day Project).

Field trips, displays and seminars on geology, plants and animals, and water quality and quantity. (April)

Illinois Environmental Protection Agency

Will pass out Redbud tree seedlings at vehicle emissions testing sites (March-April).

Will sponsor Household Hazardous Waste pickups at selected sites. (Spring '90)

Illinois Department of Mines & Minerals

Video on Mine Reclamation Techniques for school children in southern Illinois. (Spring/Summer '90)

Illinois Department of Transportation

Will display environmental/educational information at Illinois rest stops (April)

CONTACTS
EARTH DAY 1990 AND BEYOND

STATEWIDE:

State Agencies

Agriculture:
217/782-4884

Commerce & Community Affairs:
217/785-6079

Conservation:
217/782-7454

Energy & Natural Resources:
1-800-252-8955

Environmental Protection:
217/782-3397

Mines & Minerals:
217/782-6791

Nature Preserves Commission:
217/785-8686

Other Organizations

Sangamon State University
Environmental Studies
217/786-6720

Illinois Environmental Council
Virginia Scott
217/544-5954

REGIONAL:

Northern Illinois

Earth Day '90 Project
North Pier Terminal
Paul Miller
312/321-8088

Illinois Audubon Society
Mary Blackmore
815/235-8274

Earth Day Coordinating Committee
Severson Dells Nature Center
Don Miller
815/335-2915

Natural Land Institute
Karen Johnson
815/732-2111

Armchair Activists
Sinnissippi Audubon Society
Lynda Cornwell

Quad Cities Audubon Society
Tom Rockwell
309/799-5812

DuPage County
Department of Environmental Concerns
708/682-7373

McHenry County Defenders
815/338-0393

Central Illinois

Channel 12 - WILL/TV
Leslie Epperson
217/333-1070

Earth Day '90 Coalition
Kim Majerus
217/351-4016

McLean County
Soil & Water Conservation District
Jane Brown
309/662-1014

Sangamon Valley Sierra Club
Tom Smith
217/522-1011

Southern Illinois

Proud Partners
Louie Tiemann
618/233-1000

Carbondale Clean and Green
Jean Foster
618/529-4148

Shawnee Sierra Club
John Kirkpatrick, Chair.
618/893-4663

WASTE NOT, WANT NOT

by William Furry

Every year Americans bury 250 million tons of trash in landfills - everything from dirty diapers to refrigerators, aluminum soda cans to empty jars of peanut butter, chicken bones to newspapers. In Illinois we bag up 14.2 million tons of garbage every year, and like some unconscionable hound with a soup bone, we dash outside and bury our treasure in the ground. But Illinoisans don't unearth their treasure at some later date and make good use of it. We bury it and try to forget it.

Sorted glassware

A New Plan of Attack

Illinois is running out of time for finding a solution to its solid waste problems. "All things remaining constant," says Illinois Environmental Protection Agency (IEPA) spokesperson Will Flower, "that is with no new landfills and waste disposal continuing at the present rate, Illinois landfills will be filled to capacity by the late 1990s." For some regions of the state, especially metropolitan areas, a five-year timetable is more realistic.

In 1986 Governor James Thompson signed into law the Solid Waste Management Act (SWMA), with specific mandates to reduce solid waste production throughout the state, reduce Illinois' reliance on landfills, and encourage alternative means of solid waste management like recycling. The act set out a five-point waste management hierarchy of ideal steps to reduce waste. In descending order of preference, these steps are:

- Reduce the volume of waste at its source
- Recycle and reuse
- Incinerate solid wastes to recover energy
- Incinerate solid wastes to reduce volume
- Dispose of solid wastes in landfills

The Illinois Department of Energy and Natural Resources (ENR) is the lead agency in adminstering the act. "It's an umbrella policy," according to Tim Warren of ENR's solid waste office, "defining what the state's programs and roles should be in assisting local governments in dealing with their solid waste problems."

Funding Alternatives to Landfills

The recently enacted Solid Waste Planning and Recycling Act provides financial incentives for counties to emphasize alternatives to landfills. That act and subsequent legislation require all of Illinois' 102 counties to submit plans to the Illinois Environmental Protection Agency detailing how they will conform to the five-point waste reduction hierarchy in the Solid Waste Management Act.

Counties with populations of 100,000 or more have until 1991 to submit their plans to IEPA. At the end of the third and fifth years of each plan, 15 percent and 25 percent respectively of all municipal wastes generated in each county are to be recycled. Counties with less than 100,000 population have until 1995 to submit their plans and until the year 2000 to achieve the 25 percent rate of recycling.

The Solid Waste Management Fund was established under the 1986 legislation to finance IEPA and ENR assistance programs. The fund, derived from a surcharge on tipping fees imposed on waste haulers, allows ENR to offer grants and loans for solid waste recycling, market development, composting, education, technical assistance, and research and demonstration projects. Recently $18.3 million was released from the fund to ENR and IEPA.

According to Warren, "Our recycling grants program initially assisted communities with recycling activities, such as drop-off/buy-back centers and curbside collection programs. We have provided matching funds to 126 communities. Curbside service didn't exist anywhere in Illinois just four years ago. Now we have curbside service in 46 communities serving close to 450,000 households, or about one million people statewide."

The department's Market Development Program provides low interest loans and grants to private industry, government agencies and not-for-profits for manufacturing operations that use recycled material feedstock, promotional and marketing expenses for recycled-content products, and procurement and testing of recycled-content products. The

Market Development Program works to stimulate demand for recycled materials in Illinois, with an overall goal of sending less waste to Illinois landfills.

Should We Legislate Recycling?

The solid waste problem is not unique to Illinois. Several states have passed mandatory recycling laws which prohibit the landfilling of newspaper, magazines, corrugated boxes, glass, aluminum cans, plastic packaging, tires, and other recyclable items. New Jersey, Oregon, Michigan, Connecticut, Florida, New York, Massachusetts, and Wisconsin all have legislated or are preparing to legislate recycling. Is Illinois lagging behind? Tim Warren doesn't think so.

"We have not embraced the concept of mandatory recycling in Illinois because we feel that we are doing an extremely good job of making voluntary recycling work," he says. "Markets are having enough problems keeping up with the supply of materials generated on a voluntary basis. Just look at the gluts on the East Coast that followed mandatory recycling. Aggressive market development is a must."

Warren reports that, on the average, 62 percent of the households participating in the 46 curbside recycling programs statewide take advantage of the service. Sixty-two percent participation in just three years is commendable. But 62 percent of 450,000 households is a far cry from full participation by the state's 12 million waste producers. And, says Warren, the majority of ENR's attention and budget has been focused on solid waste management in the residential sector.

Getting industry involved in recycling sometimes takes a group lobbying effort. Warren tells the story of how the Great Lakes Recycling Officials, an ad-hoc group of midwestern state recycling officials, sought a coding system to help identify the various plastics used in consumer packaging, a first step in improving the recyclability of plastic containers. The group invited officials from the Society for the Plastics Industry (a trade association for all plastic companies in the U.S.) to help them solve the problem. The plastics industry obliged with a voluntary plastics coding system which places different types of plastics into seven categories. That system will help consumers in identifying plastic household items that are potentially recyclable, and assist processors in sorting plastic containers to improve their marketability.

14034CV
BLOOMINGTON
TRUCK PARTS
BLOOMINGTON, ILL.
BLOOMINGTON
TRUCK PARTS
BLOOMINGTON, ILL.

Heading to the factory

Plastics are a major headache for recyclers. In Illinois only 11 of the state's curbside recycling programs are currently accepting plastic containers. Worse is that only a few of the seven categories of plastic packaging now on the market are really recyclable. Multi-laminate containers like plastic juice containers, squeezable ketchup bottles, microwave food packages, and dozens of other packages cannot be recycled.

But recycling plastics can make a difference. Recycled plastic generally costs manufacturers less to use than virgin plastic, and it saves energy.

The Paper Chase

Old newspapers, which make up about six percent of what goes into landfills nationwide, are another area of concern. Nationally, paper products average 38 percent of all landfill waste, including corrugated cardboard (10 percent); diapers (one to two percent); magazines (three percent); newspapers (six percent); and miscellaneous paper products (18 percent). Currently Illinois has only one mill making newsprint from recycled papers - the FSC Paper Mill in Alsip, Illinois. FSC is one of seven paper mills in the country manufacturing newsprint from old newspapers; the rest use virgin fiber in their product. While some Illinois newspapers use FSC sheet, many have yet to jump on the bandwagon.

According to Warren, ENR has been working with FSC to get more newspapers to voluntarily use the recycled newsprint, but "like any sort of recycled product, there are always concerns over quality, availability and price. The biggest institutional barrier to a recyled product is that people say 'it's inferior', or 'it's not going to work as well.' " The FSC mill was built in the sixties, and the owners have recently spent millions of dollars to improve their technology. And in January, FSC began marketing tissue and towel paper made from scrap paper recycled in Illinois.

Getting newspaper companies to print on recycled paper is a struggle. According to an October 1989 article on paper recycling in *The New York Times*, approximately 60 percent of all newsprint consumed in the United States comes from Canada, where most of the trees and mills are located. To be most efficient, recycling paper mills need to be located close to where the raw material is. The department is trying to get a major recycling paper mill to locate a plant in the midwest. That facility would serve as an additional market for midwest-generated newspaper from Illinois, Michigan, Ohio and Indiana. It is an expensive proposition. "To bring a recycled newsprint mill on line," says Warren, "costs about $100 million. It is not a small capital investment."

Think Globally, Act Locally

The state has done a remarkable job in a very short time in bringing the solid waste problem to the attention of the general public, but the bottom line is that there is still a long way to go before Illinois substantially reduces its reliance on the landfill. The best way for the average citizen to help is to "think globally and act locally."

Neighborhood recycling, Champaign

Bale of milk jugs

Here are some guidelines to follow:

Reduce the amount of waste generated in the home. Buy food items in bulk, which usually come with less packaging, (i.e. less waste). If you must buy individual food items, look for products in recyclable packaging.

Stop throwing away recyclable or reusable goods. Find out where you can take recyclable goods in your neighborhood. In Illinois, call the ENR Information Clearinghouse at (800)252-8955 for more information.

There are three types of recycling: reuse, reversion and transformation. Recycling works best when you reuse the original product over and over again (like cloth diapers). The second best recycling method is when you revert a product into its original form (old newspapers into recycled newsprint). The least efficient recycling method is when you transform a material into a secondary form (plastic milk jugs into plastic lumber or flower pots).

Material preparation is important. At home, you should bundle up your newspapers, wash and rinse glass containers, and bag aluminum cans. Send yard waste to a composting site, start your own backyard compost pile, or better yet, leave grass clippings on the lawn. Use cloth napkins and towels whenever possible. Take your own grocery bags to the store, or take reusable tote bags. If you change your own oil, take the old oil to a service station that recycles oil.

Start paying attention to how your community is taking care of its solid waste problems. Don't assume you are not part of the problem.

Buy recycled products. It takes about 95 percent less energy to make an aluminum soda can from recycled cans.

Find out if your local newspaper is printed on recycled paper. If it is not, find out why and see what you can do to change the policy. A ton of recycled newsprint can save as many as 17 trees, and newsprint can be recycled as many as five times.

Be an aggressive recycler. Don't be satisfied with the state's minimum recycling goal of 25 percent by the year 2000. Governor Jim Thompson challenged all Illinoisans in his January State of the State speech to recycle half of the state's waste by the end of the century. According to IEPA, six percent of municipal waste statewide is already being recycled. If all landscape wastes are diverted from state landfills by July 1, 1990 as mandated by current law, another 15 to 20 percent of our waste problem will be solved. With an aggressive recycling push and waste reduction effort, we'll see less and less reliance on landfills.

Start a recycling program in your office to cut down on waste. IEPA and ENR both have information on starting an office recycling program. Contact IEPA's Office of Public Information, 2200 Churchill Road, P.O. Box 19276, Springfield, Illinois 62794-9276. Or write to ENR's Information Clearinghouse, 325 W. Adams, Springfield, Illinois 62704.

And remember, what goes around, comes around, especially garbage. ■

COMMUNITY RECYCLING CENTER

Recycling facility

EARTH DAY EVERY DAY

by Tara McClellan

"As the human impact upon our land increases, evidence is mounting that we have not lived as wisely as we should. This, then, is what Wildlife Prairie Park is all about. We believe that it is not too late to change our ways."

This quote, taken from the Park's informational materials, sums it up: It's not too late. Let's change. But instead of verbally ramming those beliefs down the public's throat, Park developer William Rutherford personifies them. He has energetically constructed a living museum to teach his ideals.

American elk

A Pioneer Project

Wildlife Prairie Park...a home where the buffalo really do roam, not to mention the bobcat, black bear, cougar, raccoon, elk, fox, wolf, deer, coyote, opossum, quail, geese, and others. The Park is 1,860 acres of natural habitats and "buffer zones" for about 35 species of animals and numerous plants indigenous to Illinois. Many of the species are endangered in the country or the state, and some are extinct in Illinois. The Park also includes walking trails, a visitor center, restaurant, meeting rooms, some lodging, a museum, playgrounds, and other facilities.

Rutherford, an attorney by profession, never expected to develop a nationally recognized park at the age of 60 (he's now 75), it just evolved. In the 1960s Rutherford heard that the Brookfield Zoo was looking for space to raise exotic endangered animals. Coincidentally, the Forest Park Foundation, a "small foundation" that Rutherford's family has run since 1939, had acquired 480 acres of land (including abandoned strip mined land) near Peoria with the intention of using it for conservation and environmental purposes. The Foundation, whose original efforts centered around geriatrics and handicapped rehabilitation, thought its land was the answer. It was a good location for the zoo's project and would be a boost for Peoria.

Brookfield agreed. But later their management changed, and their plans did, too. Since the Foundation had already started planning for the zoo's project, it decided to develop its own project.

"Instead of being a poor cousin to Brookfield or Lincoln Park, we thought 'Let's do something they can't do. We have more space. Let's show Illinois as it was,'" Rutherford explains. "So we tried to emphasize this part of America at the time the pioneers came."

Over the next three to four years native Illinois animals (and those brought by the pioneers) and plants were acquired, construction materials were secured (many were "used" and were recycled by the Park), buildings were designed by Rutherford's wife, Hazel, and were finally erected, and, of course, money was raised.

"The head of the Peoria park system said to me, 'Bill, if you do the things you're talking about, it'll cost you a million dollars.' And I said 'It can't. I've got the land. I've got most of the fences in. I've got the entrance road in.' Well, it cost me $11 million," Rutherford chuckles.

Rutherford, a former Director of the Illinois Department of Conservation, used some seed money from his family's foundation and raised the rest. The sources for nearly all of the material, land and financial donations weren't big corporate sponsors or other deep pockets, he says, but "very modest people that believed so much in and trusted us." He gives two examples of a lonely farmer and a former schoolteacher, for whom he did some legal

American bison

work. They ended up leaving nearly everything they had to the Park because they believed in it.

A Stack of Pancakes

Rutherford's philosophies molded the Park's purposes: to conserve, to educate about wildlife and the environment, and to be fun. The Park is a Disneyland of conservation. But Rutherford's message is very different.

"I didn't want rubber monkeys," he says of the Disney comparison, though he's flattered. "I'm not trying to keep the animals animated, I want to keep the real world. There's enough magic and marvel in our plants and insects and birds...that all we've got to do is let people learn how to see them."

The Foundation's main idea for the Park was to provide an example to teach others. "We felt that somewhere, somehow we could...innovate and find answers to these problems of awakening the public on a local basis. And hopefully if that could be multiplied and magnified by other people seeing that you can do it, without government bureaucracy and waste and interference, then maybe other folks could do it. And like a jigsaw puzzle, enough pieces will come together to do that which is not being done."

Rutherford's philosophies and hopes for the Park are manifold. He believes in what he calls the "stack of pancakes" theory, where each pancake represents a different benefit that can be derived from a single act or expenditure. "The fun is to get as many times the value for each hour you work and each dollar you spend as possible," he says. "It's a way of multiplying your effectiveness."

Rutherford believes some of the Park's benefits include teaching conservation, decreasing waste, helping the handicapped, promoting the family, and helping Peoria's economic development. Rutherford says since visitors no longer have to travel to distant places to see a clean, enjoyable park, gas will be saved. In turn, fewer cars on the road mean fewer accidents and fewer injured people. Family togetherness is promoted because the Park is a place where "three generations" can find similar interests. Cleanliness is promoted because children, the next generation, will learn from the Park's immaculate operations (not a scrap on the trails). Rutherford also believes the Park will increase the area's recreational value, which will in turn help attract prospective industry and keep more industrious Illinoisans at home instead of being lured to other states.

William Rutherford and his dog, Frosty.

A World Regained

These philosophies are like gentle subplots weaved through the Park's design. An example is the Clivus Multrums waterless, flushless toilets that save a million gallons of water annually and eventually produce a compost that is used to create the Park's fertilizer supply. (Nothing is wasted here.) And as you stroll down the pleasant trails viewing rare Illinois animals in their natural habitats, the importance of conservation and saving the environment hits home. It's hard to realize that the sleepy bobcat kits lounging in a treetop, or the black bear napping in the sun, once populated the length and breadth of this state.

There are about 10 miles of walking trails at the Park, many featuring a particular animal or kind of animal. After trailwalking you can picnic at a number of tables or shelters throughout the Park or eat at the indoor restaurant. Visit the museum, gift shop, or country store during the summer, or take a ride on the "Prairie Railroad." The Pioneer Area features domestic prairie farm animals, a log cabin and an 1800s schoolhouse. If you'd like to spend the night, you can stay in a real caboose (with "jiggler" mechanisms to simulate train travel), in tepees, or in a log cabin that overlooks the Park. The Park has numerous special events and naturalist programs throughout the year.

And Rutherford plans more. He hopes to have a 100 to 120-room lodge built "as soon as possible." A new deer park (across the street from Prairie Park) may be completed this summer. New trails in both parks are also on his wish list, as well as airmail from the Park via racing pigeons.

In terms of long-range goals, Rutherford wants to increase the Park's convention business and expand the Park's land to prevent development from encroaching on and ruining the area's mystique. He hopes to make the Park "a focus of applied environmental items," where the best of young and old students alike can learn from each other by researching environmental issues, and where environmental foundations can experiment with their visions.

Do Something

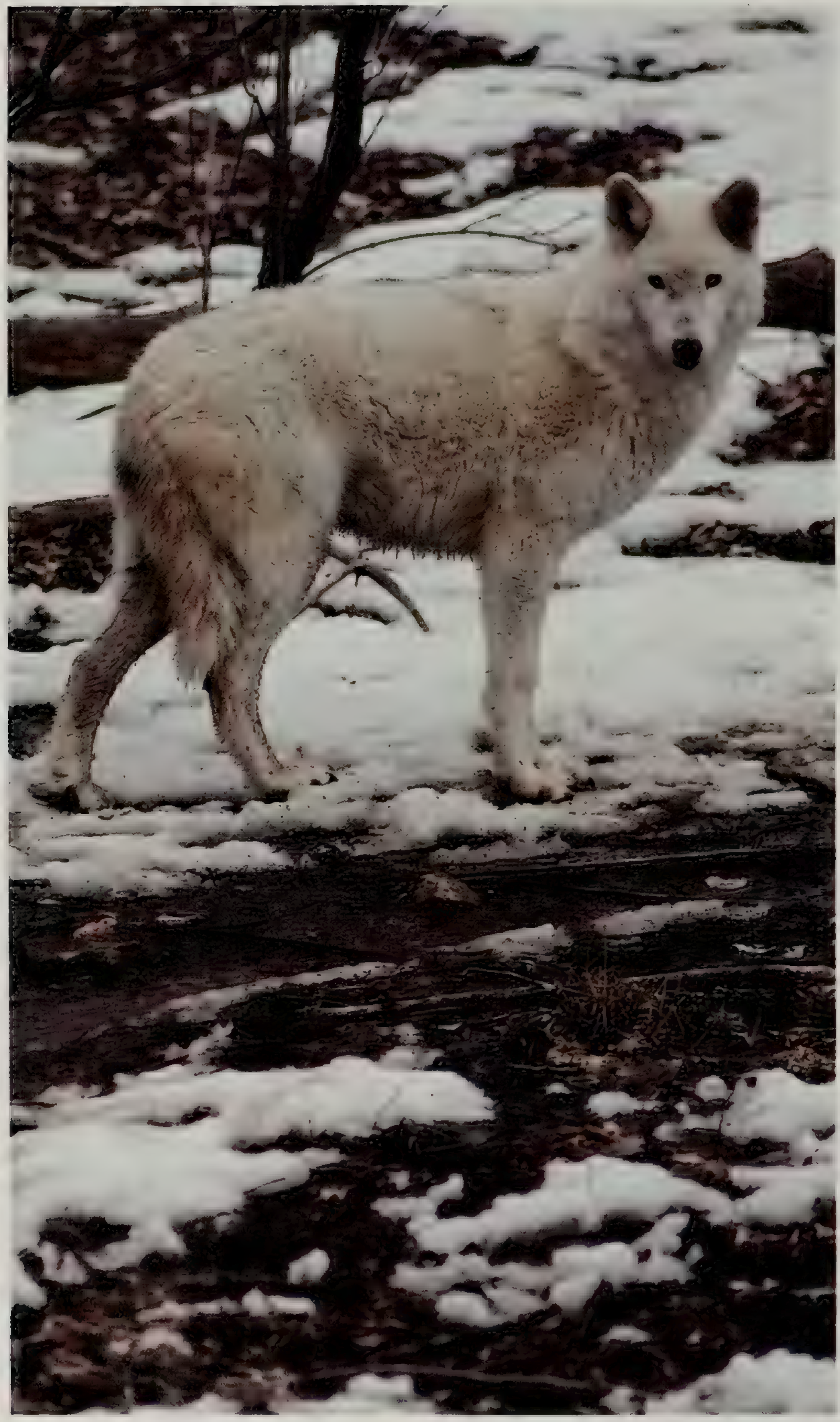
The point of the Park is to get everyone to experiment, to start conserving and nurturing the environment today, to live Earth Day every day.

"It's perfectly affordable and available to everybody," Rutherford says. "Let's start on our waste, the number of lights and the amount of heat that are used needlessly, and the needless use of the automobile...walk more."

Don't waste food, he suggests. Instead of hunting animals, take their pictures. ("The use of a camera gives more satisfaction...there are better things than a trophy.") Practice moderation in all things, he says. Don't buy gas guzzler cars. Recycle, too. And finally, volunteer. (Rutherford, a volunteer for several environmental and other organizations, knows the personal and economical value of this suggestion. At least 200 volunteers help run the Park and provide 29,000 work hours annually.)

Most importantly, do something. If complacency were a china shop, Rutherford is the bull that ran through it. He has a plaque attached to the visitor center with a favored quote by Rachael Carson. It reads: *"Have we fallen into a mesmerized state that makes us accept as inevitable that which is inferior or detri-*

Visitor's center



Wolf, born at Wildlife Prairie Park

mental, as though having lost the will or the vision to demand that which is good?"

It is tempting to lionize this vibrant 75-year-old man who still works 14-hour days seven days a week, bombarding his staff with a constant stream of memos on improvements and ideas, bringing to life ideas that most just talk about. He has been called a visionary. He is.

"That's nice," he says. "But I don't worry much about those things. I just want to get a few things done."

The Park is located off Interstate 74 via exit 82 (Kickapoo-Edwards) on Taylor Road between routes 8 and 116. It is 10 miles west of downtown Peoria. Admission is free for children aged four and younger. The admission then varies between $1.25 and $4.00 depending on the visitor's age and the day (weekends are slightly higher). The Park is handicapped-accessible and is open year-round, but closes on Saturdays from December through March. Hours vary depending on the season. Group rates are available, Wednesdays offer a "special carload rate," and Thursdays are for Senior Citizens. For information call the Park at (309) 676-0998. ■

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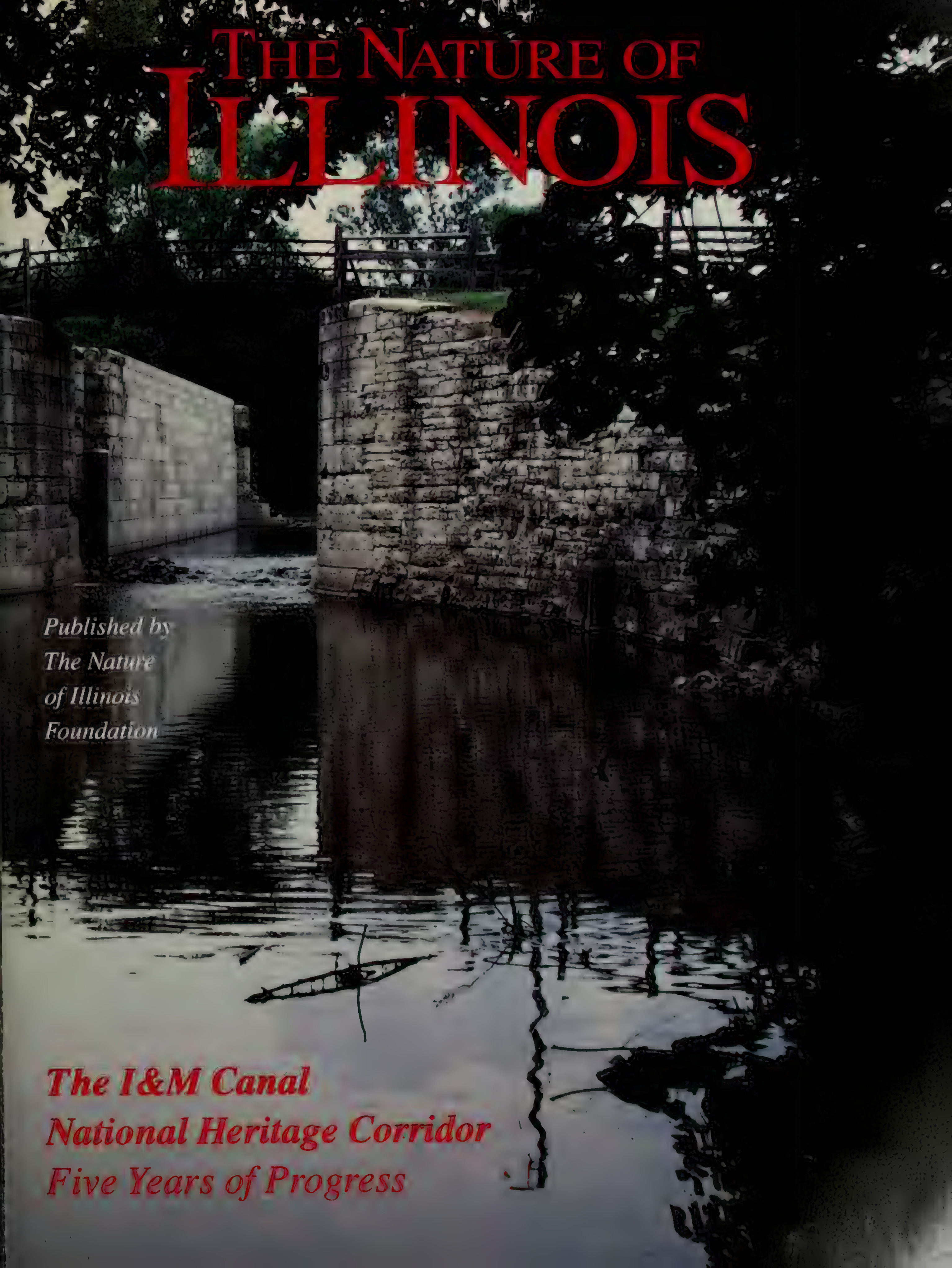

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The I&M Canal National Heritage Corridor Five Years of Progress

THE NATURE OF ILLINOIS

The I&M Canal National Heritage Corridor—Five Years of Progress

Fall 1990

I have long been an advocate of public/private partnerships in conservation efforts. There is no better example of this than the Illinois and Michigan Canal National Heritage Corridor. While federal funds have been spent to develop the Corridor, more than $10 million in state, local and private monies have been put to good use in restoring historic structures and preserving open lands.

The Illinois and Michigan Canal is much more than a canal. The Corridor around it extends over 100 miles from Chicago to LaSalle-Peru, and encompasses some 450 square miles of the industrial heartland and prime farmland of Illinois.

The Corridor's goals are many: to preserve an important part of Illinois' history, to conserve some of the best of our state's natural areas, and to revitalize the region's economy. It has been six years since Congress designated the Illinois and Michigan Canal as the nation's first National Heritage Corridor. It is time to look at our progress and to make sure that all Illinoisans know about this precious historical and natural treasure.

The Illinois Scientific Surveys have played key roles in researching and preserving the natural riches of this area. They are now deeply involved in current efforts to rehabilitate the Canal itself and surrounding environs.

This special issue of **The Nature of Illinois** is another public/private partnership, brought to you by **The Nature of Illinois Foundation** and the Illinois and Michigan Canal National Heritage Corridor Commission.

I hope you will join me in becoming a member of the Foundation, and in sharing my delight in the I&M Canal Corridor by visiting there.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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About the Cover

Restored Lock No.1, Lockport

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Editorial Staff
Jane A. Bolin *Editor*
Jean Gray *Associate Editor*
Estie Karpman *Assistant Editor*
Michael Jeffords *Photographer*

Design
Mobium Corporation, Chicago

Stay In Touch

Name, address or delivery changes, membership information, should be sent to The Nature of Illinois Foundation, 208 S. LaSalle, Suite 1666, Chicago, IL 60604, 312/201-0650. Master Card and Visa accepted.

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ATURAL HISTORY SURVEY

OCT 17 1990

THE ILLINOIS AND MICHIGAN CANAL

THE FIRST NATIONAL HERITAGE CORRIDOR

> *The National Heritage Corridor movement weaves together the historical, recreational and economic development threads of the region. The Illinois and Michigan Canal has served and will continue to serve as a model for many future Corridors.*
>
> Dr. Bruce McMillan,
> Chairman, I & M Canal
> NHC Commission

Aux Sable Lock overflow channel

A Victim of Neglect

Little more than a century after horses and mules pulled their first burdens along towpaths from Chicago to LaSalle, the Illinois and Michigan Canal lay fractured and neglected. Hidden by dense foliage, fouled by siltation, and filled with debris, its limestone levees were crumbling and its wooden locks no longer swung open and shut to control the flow of waters. The Canal was fragmented between Joliet and the turning basin at Bridgeport. It was totally obliterated between Chicago and Summit, buried beneath the Stevenson Expressway.

Between Channahon and Morris, where spillways were still in place, water continued to flow through the Canal, but most neighbors counted the I & M anything but a blessing. In some places shallow, stagnant water made it a breeding ground for mosquitoes and a medium for an unpleasant mix of smells. During heavy rainfalls, the Canal overflowed its banks, flooding basements, yards, and fields. (See *Surveying the I & M*, this issue, page 25.)

On the land on either bank of the Canal, however, slumbered wonderful forest preserves and wetlands, bird sanctuaries and prairies. Impressive geological outcroppings provided evidence of early dramatic Ice Age events. Hidden beneath the land, archaeological treasures whispered of prehistoric moundbuilders and the early days of Indians and French fur traders.

The area from Bridgeport to LaSalle was a treasure trove of 19th-century buildings in conditions that ranged from pristine to barely standing. These kinds of architectural gems no longer existed farther east, destroyed either by the Chicago Fire of 1871 or by the relentless wrecking ball of progress.

Early Efforts at Renewal

There were early signs of recognition of the region's recreational opportunities. As early as 1933, the Civilian Conservation Corps was building recreational facilities on the Canal, restoring Canal buildings and locks from Chicago to LaSalle, and beginning construction on the now famous Starved Rock Lodge. The Department of the Interior inventoried thousands of valuable documents at the Canal headquarters in Will County and put together a list of sites and structures on the Canal – each site was to have its own interpretive sign.

World War II halted this progress.

Prospects for the Canal looked bleak again in the 1960s when the state of Illinois assessed the value of abandoned I & M Canal lands and prepared to sell off parcels in order to generate state revenue. Word got out that the Illinois Department of Conservation was directed to "dry it up and do away with it."

The timing was right when the Open Lands Project was formed in 1963 to conserve public open space in northeastern Illinois.

Assuming a leadership role in preserving the I & M Canal, Open Lands initiated a drive to establish the Canal as a linear historical park and recreational trail.

By 1974 citizen action and the Open Lands Project resulted in the designation of the I & M Canal State Trail, a 60 mile-long park that followed the Canal and towpath from Joliet to LaSalle/Peru

In the meantime, small but determined groups of concerned citizens organized town meetings, circulated petitions, and confronted their legislators. The grassroots effort drew support all the way up to the Governor's office.

With a $5,000 state grant, free labor, and materials and trucks donated by local businesses, volunteers began the process of hacking out trails and repairing footbridges. Restoration was begun on the 1837 Canal headquarters, now the home of the Will County Historical Society I & M Canal Museum.

In Utica, an 1848 limestone canal company store (today the LaSalle County Historical Society) was saved from demolition, as was Ottawa's 1856 Reddick Mansion, one of the finest examples of Italianate architecture in Illinois. The rescue was sponsored by the National Trust for Historic Preservation and the Ottawa Silica Company.

The LaSalle County Volunteers undertook restoration of several miles of the Canal at its western end.

Expanding the Vision

The scope of the project was broadened further when Judith Stockdale, Executive Director of Open Lands, hired Gerald Adelmann to spearhead the 1980 Des Plaines River Project. His mandate was to inventory and assess the richness of that piece of the Canal Corridor excluded from the state's 1974 designation. Adelmann's background in historic preservation, urban planning and American history added a new dimension to the open space focus of the previous project.

The picture that emerged from Adelmann's survey took his breath away. There, at the doorstep of the Chicago metropolitan area, easily accessible to seven million residents, was a treasure of natural and recreational areas, historic buildings, and cultural artifacts connected by the spine of the I & M Canal all the way to LaSalle/Peru.

And far from the detriment it appeared to be when the Illinois State Trail was designated in 1974, the heavy industrialization of the northeast end of the Corridor suddenly seemed to be a plus. Steel mills, oil refineries, open quarries, bridges, dams and water works hopscotched the I & M and Sanitary and Ship Canals and the Des Plaines River. In the backyards of Shell Oil, Commonwealth Edison and Texaco, between the canals and railroad yards, was hidden one of the richest concentrations of natural areas and open lands in the entire state. Ironically, they were in a wonderful state of preservation due to long isolation behind industry's chain link fences.

Here was the story of the settlement of the entire Upper Illinois Valley, from prehistoric Indians to industrialization.

"We began looking for labels and approaches big enough to contain the dream," said Adelmann. It was clear no traditional park would emerge.

Adelmann shared his vision with *Tribune* outdoor writer John Husar. He caught Adelmann's Corridor fever and for three months the two explored the Canal, gathering material for "Our Hidden Wilderness." This six-part series would appear in the *Chicago Tribune* in the fall of 1980 and ultimately be nominated for a Pulitzer Prize.

RIALTO
SQUARE

Rialto Square Theatre, Joliet (Exterior)
(Courtesy: Rialto Square Theatre)

The project gathered steam and Adelmann, Stockdale and Husar began to build coalitions.

Open Lands sponsored separate briefings for three groups. Group one included users and activists - the Sierra Club, the Audubon Society, equestrians, hikers, snowmobilers and canoe paddlers. Group two was comprised of historians, anthropologists, archaeologists, geographers and historic architects. The third group - governmental agencies - included the Metropolitan Sanitary District (now the Metropolitan Water Reclamation District of Greater Chicago), the Illinois Department of Conservation, the Illinois Department of Energy and Natural Resources, county, city and state officials, the U.S. Army Corps of Engineers and the Illinois Scientific Surveys.

Drawn in by growing public and private response, Senator Charles Percy and Congressman Tom Corcoran requested the National Park Service to draft a conceptual plan "...to protect and enhance the abundant cultural and natural resources of the I & M Canal while at the same time providing for economic development."

More than 100 local citizens and officials helped write the National Park Service document. Starting with a local initiative, it called for federal involvement through the creation of a commission to coordinate development of the Corridor with technical assistance from the National Park Service.

The Lions Lie Down With The Lambs

It was a unique marriage. Leaders from business and industry sat down with environmentalists.

Initially nervous that federal involvement might trigger more stringent air and water quality standards, land use controls or a federal land grab, local business and industry ultimately saw the plan as a unique opportunity to foster economic development.

The drafting of the legislation that followed was as unique as the concept itself. It was written not in Washington but, again, by local people with help from the Illinois congressional staff.

The aim of the legislation was "...to retain, enhance, and interpret, for the benefit and inspiration of present and future generations, the cultural, historical, natural, recreational, and economic resources of the corridor..."

The bill was supported by the entire Illinois delegation and signed into law by President Ronald Reagan on August 24, 1984.

The I & M Canal Corridor was now nationally recognized as historically significant. Its 19-member federal Commission, created by the legislation, would be the leading public sector coordinator of I & M Corridor development, charged with developing an identity for the Corridor through interpretation, signage and public education.

Its $250,000 annual budget funded a small staff. The commissioners were selected to represent the interests of preservation, conservation, recreation, business and industry, and governmental agencies.

The Upper Illinois Valley Association is the leading private-sector organization working to coordinate the Corridor's diverse interests and implement its goals. An offshoot of the Open Lands Project, the not-for-profit association was formed in 1982, according to Judith Stockdale, to bring an economic development perspective to the project and include more Valley area participants.

The First Five Years

One of the Commission's first acts was to create the distinctive I & M logo to promote unity within the Corridor. A low-range radio transmitter system has been established to broadcast messages welcoming visitors to the area, telling them how to get to the nearest visitor information center, and pointing out the special attractions and events. Forty new wayside interpretive displays will be in place at selected sites this fall.

The Commission distributes the National Park Service *Illinois & Michigan Canal* brochure and *Ice Age Geology*, an interpretive brochure on the geological history of the area authored by the Illinois Geological Survey. The National Heritage Corridor Journal publicizes hundreds of local weekly festivals and events in the Corridor, and each of the forest preserve and park districts, museums, towns and visitor centers distributes its own interpretive material.

Two extraordinary guides are currently being prepared under the direction of Michael Conzen, Professor of Geography at the University of Chicago, as a joint effort of the Commission and the

Rialto Square Theatre, Joliet (Interior) (Courtesy: Rialto Square Theatre)

Upper Illinois Valley Association. Professor Conzen, who was responsible for early map work delineating Corridor boundaries, says that a fold-out map and auto tour guide, patterned after a European model, will be ready this fall.

The second project, due out in 1991, is a comprehensive guide with stunning photographs and essays on the area, its history and its heroes; interpretations of geological, architectural and archaeological sites; detailed maps with driving and walking tours; a directory of places to explore and a bibliography.

When A Canal Is More Than A Canal

When people think of the Corridor, they think of the physical canal. "It's really the broader landscape," points out Adelmann. "The Canal in many areas is the dominant feature. In some areas it doesn't even exist. There isn't and never will be enough money to restore it to its original state even if that were desirable." The focus is on restoration where feasible, stabilization where restoration is out of the question, and general beautification through landscaping and interpretation.

Since its transfer to the Illinois Department of Conservation (IDOC) in 1974, more than $4.5 million has been spent by that agency on the Canal, its trails and its towpaths. David Carr, regional land manager for IDOC, says that the Canal's prominence since 1984 has led to an increase in state allocations. One-and-one-half million dollars is budgeted for the current fiscal year.

Twenty-six miles of trails have been restored by IDOC between Channahon and Morris, and more trails are planned. Additional systems of trails for biking, hiking and snowmobiling wind through forest preserve districts, and there are miles of canoe trails. (See *A Guide to the I & M*, page 13).

One of the earth sculptures at Effigy Tumuli, Buffalo Rock State Park (Courtesy: Edmund P. Thornton)

A vital key to the National Heritage Corridor system is **The Centennial Trail**, a project of the Metropolitan Water Reclamation District (MWRD) of Greater Chicago. It will join the city of Chicago to the Lockport Historical Trail and, when completed, run through lush forests and wetlands and weave among three historic waterways: the I & M, the Sanitary and Ship Canal, and the Des Plaines River. The trail will originate at the Chicago Portage site at Harlem Avenue (a National Historic Landmark), where a major visitor center is planned. An important link in the integrated 900-mile trail system envisioned for northeastern Illinois, it is a stunning example of intergovernmental cooperation. It is located largely on land owned by the MWRD and will be managed jointly by the Cook, DuPage and Will County Forest Preserve Districts.

The **River Edge Renaissance** proposes a green belt scenic corridor and trail along MWRD's river edge land. It will have a historical site at each end of the Cal-Sag Channel supported by a mix of public and private funding. Within a generation, as lands leased to industry turn over, new regulations will require river edge setbacks. The last lease turns over in 2053. "It may seem like a long wait," says George Kelley, supervising architectural planner for the District, "but from then on...*forever*!"

St. James of the Sag Church and Cemetery is honored with a designation on the National Register of Historic Places. The picturesque church and tombstones (the oldest identified in Cook County) have been saved for long-term preservation.

The Gaylord Building in downtown Lockport is a private/public partnership forged to meet the goals of the Corridor. Built in 1838, the building originally warehoused Canal construction equipment. Under the leadership of Gaylord Donnelley, an approximately $2 million rehabilitation project was undertaken to restore the dilapidated limestone building to pre-Civil War grandeur. Today the Gaylord Building houses the acclaimed Public Landing Restaurant, a gallery of the Illinois State Museum, and a visitor center operated by IDOC.

Completed in 1987, it was the first major restoration project of the National Heritage Corridor and inspired other revitalization projects in downtown Lockport. The building was honored by President Reagan in 1988 as one of the nation's most significant historic restoraions.

Gallery records counted 48,582 visitors from May, 1987 to June, 1990, and an economic impact study reported that visitors spent in excess of $315,561 in the Lockport region during this period. Of this amount, $131,169 was spent during 1989.

The Rialto Theatre in Joliet is a spectacular $8 million restoration that today is serving as a major cultural attraction and anchor for the revitalization of downtown Joliet.

(Total Corridor attendance grew from four to four-and-one-half-million visitors between 1986 and 1989. Suzanne Bobinsky, Executive Director of the Heritage Corridor Visitors Bureau, reports that tourists spent $216 million on entertainment and in restaurants, hotels, motels and gas stations in 1987.)

The Effigy Tumuli at Buffalo Rock State Park is second in scope and size only to Mount Rushmore. Eighty miles southwest of Chicago, on sandstone bluffs overlooking the Illinois River, perch five earth effigies - a snake, a turtle, a catfish, a frog and a water strider - created by artist Michael Heizer. These geometric versions of native Illinois Valley water animals reach 1,800 feet in length and 26 feet in height and refer back in time to the ancient tradition of prehistoric mound builders.

The project was initiated by Edmund B. Thornton, former Chairman of the Ottawa Silica Company, donor of the abandoned coal strip mine site. Mr. Thornton, president of the company's foundation (which paid the artist's fees), is an active member of UIVA and was the I & M Commission's first Chairman. The $1 million price tag was funded by the state of Illinois' Abandoned Mined Lands Reclamation Council. Additional funding was made available by the National Endowment for the Arts. The *Effigy Tumuli* cost the state no more than a conventional reclamation project.

Seneca grain elevator. In the foreground is I&M Canal

The Illinois Department of Conservation recently renovated and expanded **Starved Rock Lodge**. The lodge and conference center, operated by a concessionaire, anchors the southwestern end of the Corridor and is surrounded by miles of recreational trails traversing geological formations of breathtaking beauty.

An Investment Recovered

It would take a lifetime to hike all the trails, paddle all the waterways, and marvel at all the living creatures that inhabit the forests, prairies, wetlands and rolling hills in the Corridor. It would take another lifetime to attend all the festivals and special events, to explore the archives and absorb the lessons of interpretive exhibits at museums, historical societies and visitor centers.

In addition to substantial federal funds, more than $10 million in state, local and private monies have been spent on rehabilitation of structures and preservation of natural areas and land acquisition. There has been a dizzying mix of support from the state; the Metropolitan Water Reclamation District of Greater Chicago; the Will, Cook and DuPage County Forest Preserve Districts; and towns and cities along the Corridor.

The I & M Commission and Upper Illinois Valley Association have enjoyed the dedicated support of such grassroots groups as Friends of the I & M Canal, local historical societies and museums, the Audubon Society, the Sierra Club, the C.C.C. alumni, and volunteers from every city and town along the Corridor.

Business and industry have contributed dollars, land, advice and counsel. This past year Material Service Corporation donated the Briscoe Mounds, an important site of archaeological significance, to the Illinois State Museum. This fall an exhibition (with an interpretive brochure designed by Northwestern University archaeologist James Brown) is planned for the IDOC visitor center in the Gaylord Building at Lockport.

Canal towpath at Gebhard Woods, Morris

The Commission's current Chairman, Bruce McMillan, Director of the Illinois State Museum, is optimistic about increased economic revitalization for downtown districts over the next five years through such projects as the National Trust Main Street Program, the construction of Lemont's $10 million Four Winds Hospital, and the expansion of Joliet's Heritage Park (See *Rebuilding an Economy*, page 21).

"It's a hard concept to get your arms around," says Jerry Adelmann. And perhaps therein lies its value. The Corridor, with its many faces and personalities, tells stories of the earth and of nature and of human habitation. It offers the solitude of exploring a virgin prairie or the excitement of a spirited "Old Canal Days" festival.

It's all there - ready for the modern *voyageur* to explore. ■

A CANAL THROUGH TIME

by William Furry

Gaylord Building, circa 1880, Lockport (Courtesy: Upper Illinois Valley Association)

In a hand-carved bed of limestone and clay, the Illinois and Michigan Canal now sleeps, a trickling reminder of time's indifference to human industry. Once it was a bustling industrial waterway linking the Great Lakes shipping ports of the Midwest and New England to the Gulf of Mexico. But the I & M Canal's history begins long before the first shovel turned in the Canal back in July of 1836. The story begins millions of years earlier, when primordial seas swirled across the continent, and towering sheets of ice scraped along the Corridor.

Ancient Seas

More than 500 million years ago, ancient seas inundated the Midwestern landscape. Thick layers of sand shifted and settled in these ancient beds, and sediments from decaying plants and animals (crustaceans) added further layers of strata to the ocean floors. These concentrated layers of sediment became the sandstone and limestone bluffs that dominate the Corridor from Utica to Ottawa and Joliet to Chicago.

Approximately three million years ago, the first of several periods of glaciation began. Mile-thick sheets of ice crept southward from Canada and scraped through the Great Lakes Basins, flattening anything and everything in their paths. But even as these glaciers advanced they were melting, and their frigid meltwaters were trapped and pooled by ridges of glacial till and debris, called moraines.

Lake Chicago, a precursor of Lake Michigan, was one such pool. Formed more than 13 thousand years ago, this proglacial lake was impounded by the Michigan lobe of the Wisconsinan glacier and the Valparaiso moraine, an earthen barrier that formed the lake's extreme southern and western banks. As the lobe slowly retreated to the north, its rapidly rising meltwaters gouged a Y-shaped outlet in the moraine, releasing a torrent of floodwaters into the Illinois River Valley.

"Think of an ice cube in a furnace," says University of Chicago Professor Michael Conzen when describing the torrent that raged through the Corridor. "The Illinois River Valley was scoured, violently eroded by the meltwaters of the glacier."

Conzen, who has studied the Corridor's history and geology for more than a decade, says the amount of meltwater released into the valley would stagger the imagination. These torrential meltwaters were capable of carrying small boulders and stripping layers of sediment off the valley floor down to bedrock in a very short time. Scoured bedrock and boulder rubble in the Kankakee River Valley offer silent testimony to one such meltwater flood that geologists have called the "Kankakee Torrent."

The Wisconsinan glacier retreated for the last time about 12 thousand years ago. As Lake Chicago evaporated into a swampy bed, Lake Michigan formed. For a while its waters drained also into the

Illinois River Valley, but as the terrain sprang back from the weight of the glacier, the waters found a drainage bed on the eastern shore of the lake. The Y-shaped outlet in the Valparaiso Moraine became beds for two small streams - the Chicago and the Calumet Rivers. At their juncture, some twenty miles from the lake's shore, the south fork of the Chicago River flowed but three miles from the Des Plaines River. It was an easy portage in the driest months, and in the floods of spring and early summer, it offered unimpeded access to the Gulf of Mexico and the Great Lakes.

The Archaeological Record

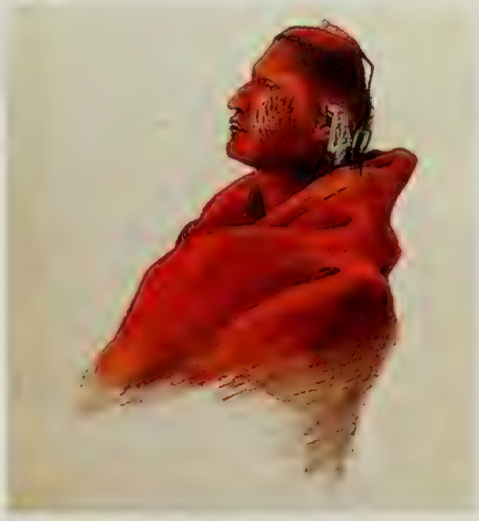
At the Isle a la Cache Museum in Romeoville, a buckskin-clad site interpreter kneels before a group of preschoolers and begins a lesson on how to build a fire. "No Native American," instructs the interpreter, "ever started a fire by rubbing two sticks together." He invites a youngster to prove his point by rubbing two sticks together. Then, brandishing a firebow, some tinder, and a sack of char-cloth, the interpreter sets to work with his primitive tools, and soon, to the delight of the children, is sending thin puffs of smoke into the air.

The Museum celebrates the history of Native Americans and French fur traders who once used this island in the Des Plaines River as a place to store their furs between trips to the trading posts. It speaks to the history of the region as a thriving commercial corridor long before the first Canal lock opened.

Paleo-Indian migration into the Canal Corridor coincides with the retreat of the glaciers. Prehistoric evidence suggests that a hunter/gatherer culture moved in and out of the area as early as 12 thousand years ago. At least three thousand years ago the first settlements appeared. But they weren't permanent settlements.

"These primitive communities settled in the river valley," says Northwestern University archaeologist Jim Brown, "and hunted on the upland plains and prairies. They hunted marsh-dwelling animals and plants like the American lotus. Twice a year - in July and early winter - they would break camp and travel great distances in search of bison and elk." In the Woodland period (1,000 B.C. to 1,000 A.D.), they cultivated maize and developed reliable agricultural economies.

Some Indians had ties to the Hopewellian culture. Chert tools and lead and copper metal fragments connect these primitive settlers to tribes as distant as the Mississippi delta. Archaeological sites (burial mounds) have been excavated at Starved Rock, in Ottawa and in nearby Utica. At the Zimmerman site at Starved Rock, three distinct settlements of Amerindian culture - Paleo-Indian, Woodland, and Mississippian - have been unearthed. Other archaeological sites in the Corridor include fortifications at Marseilles, Joliet, Palos Hills, and Starved Rock.



Massika (Turtle), Sauk Man (Courtesy: Josyln Art Museum, Omaha, Nebraska)

The Corridor's influence on prehistoric cultures, especially as it relates to ancient trade routes, is speculative. But by the time the French explorers arrived in 1673, Amerindians were using the Chicago Portage and the Corridor extensively. Amerindian population estimates for the entire Great Lakes region between 1600 and 1760 were as high as 100,000. Excavations in Chicago during the last century unearthed no fewer than twenty-one "major" Amerindian settlements along the principal waterways.

Nine major tribal groups lived in or near the region in 1673 when Father Jacques Marquette and Louis Jolliet paddled up the Mississippi and Illinois Rivers to the Chicago Portage. The Miami, Winnebago, Michigami, Fox, Sauk, Menomini, Potawatomi, Illini and Ojibay tribes were all noted and recorded by the early French visitors. By 1833, the last of these tribes had been displaced from the Corridor.

A Passage to Paris

Marquette and Jolliet explored the Mississippi River Valley seeking proof that the Father of Waters flowed unvexed to the Gulf of Mexico. When they found their proof, they turned their canoes northward to explore the Illinois River Valley. What they didn't expect to find was a passage from the Great Lakes to the Mississippi River leading to the Florida territories (those territories extending from Florida to New Orleans). When Jolliet crossed the Chicago Portage into Lake Michigan, he saw the Corridor's potential for opening up the territory at once. In a letter to a Jesuit priest in France, Jolliet reported that "we could go with ease to Florida in a bark and by very easy navigation. It would be necessary to make a canal, by cutting through but half a league of prairie, to pass from the foot of the Illinois (Lake Michigan) to the river Saint Louis (Des Plaines)."

Most of the French settlers in the Illinois territory were far more interested in pelts than in canals. They were interested in souls as well. A Jesuit mission was built near the Chicago Portage, but it was later abandoned in 1697. French *voyageurs* (canoe men) and *coreur du bois* (licensed fur traders) traveled up and down the Corridor peddling their furs at French outposts. The largest French outpost in the Corridor was at Fort St. Louis, a fortifica tion built atop Starved Rock. In 1680, nearly 10 thousand French and Indian settlers were living in the region.

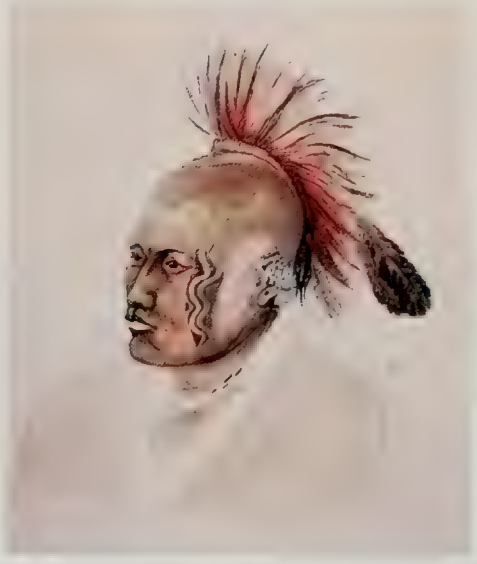
About this time the irritable Iroquois Indians moved into the Corridor. When it became evident the Illini were incapable of defending themselves against the highly organized Iroquois war parties, the French lost interest in protecting the region, and turned their efforts toward the large settlement at Fort de Chartres on the Mississippi. For nearly 100 years the French maintained control of the territory, but in 1763 that era ended. In the political aftermath of the French and Indian War, the Corridor came under the dominion of England and King George III.

But only for the next twenty years. In 1783, the American Revolution claimed the Corridor from the British, and the seed for the Illinois and Michigan Canal was planted at last in friendly soil.

Portage of Promise

The geographical importance of the Corridor was well-known to the leaders of the new nation, but because the territory was largely unpopulated, support for a canal connecting the Great Lakes to the Mississippi River was not strong. Most of the settlers in the Illinois Territory were entrenched in the prosperous south, where a brisk river trade on the Ohio River kept markets alive. In the north, hostile Indians had also moved into the region again, this time the Potawatomi and Sauk tribes. Raids and war parties continued until 1795 when the Treaty of Greenville (Ohio) was signed. At Greenville the Indians signed away control of the mouth of the Chicago River to the federal government. There in 1803, an outpost named Fort Dearborn was built on the future site of a city called Chicago.

There were only a few canals operating in the United States in 1810, and none connected major waterways. But the new nation was keen on internal improvements. In 1810 a New York legislator named Peter B. Porter proposed a series of federally funded canals to Congress, including a canal to cut across the Chicago Portage joining the Great Lakes to the Gulf of Mexico. Porter's plan had popular support for canal construction in the eastern states, but even then it wasn't until July 4, 1817 that construction was started on the Erie Canal.



Wausasse (Fox Indian) (Courtesy: Josyln Art Museum, Omaha, Nebraska)

Secretary of War John C. Calhoun realized the nation needed a northern water route to move military supplies. In 1818 he advised Congress to consider a system of roads and canals for the security of the nation.

Back in the Illinois Territory in 1816, Ninian Edwards was negotiating with the Potawatomi, the Ottawa, and the Chippewa tribes to cede their lands along the proposed Canal Corridor. Edwards persuaded the Indians that a canal would ultimately be in their best interests.

In December 1818, on the eve of Illinois' admittance to the Union, the northernmost boundary of the Illinois territory (as established by the Northwest Ordinance of 1787) did not include the Chicago Portage, nor any lake shoreline. From the foot of Lake Michigan, the territorial boundary extended in a straight line across to the Mississippi River. Without this all-important property, the state would have no access to the Great Lakes.

Nathaniel Pope, the Illinois territorial delegate to Washington, interceded in Congress on behalf of the Canal and Illinois, and the Chicago Portage and the rest of northern Illinois were admitted into the Illinois state boundaries.

Once Illinois was admitted to the Union, there was no sudden outpouring of federal funds to build a shipping canal at the Chicago Portage. Governor Shadrach Bond gave his full support to the project, however, and the Second General Assembly sent a formal request to Washington asking for money from the sale of public lands to finance the Canal. The General Assembly also asked for authority to build the Canal on public lands and for the federal government to donate those public lands. Congress authorized construction of the Canal, granting a strip of land in the Corridor for the main channel and a 90-foot border on either side.

The Canal's first board of commissioners was formed on February 14, 1823. Their charge was to plot the most accessible route through the Corridor and to estimate construction costs. By 1825, the year the Erie Canal opened, the survey was complete. The General Assembly, wasting no time, formed the Illinois and Michigan Canal Company, provided the new company with one million dollars in capital, and targeted the completion of the Canal for January 1, 1835.

But the chartered stock company could not sell its stock, and the Canal Company died. In 1827, the state asked for and again received a land grant in the Corridor. A new board of canal commissioners set to work. In 1829, they hired James Thompson to prepare a map of the Corridor and lay out the cities of Chicago and Ottawa.

The Canal that Almost Wasn't

While land speculation in the Corridor was slowly heating up, a different kind of fever was spreading in the legislature - railroad

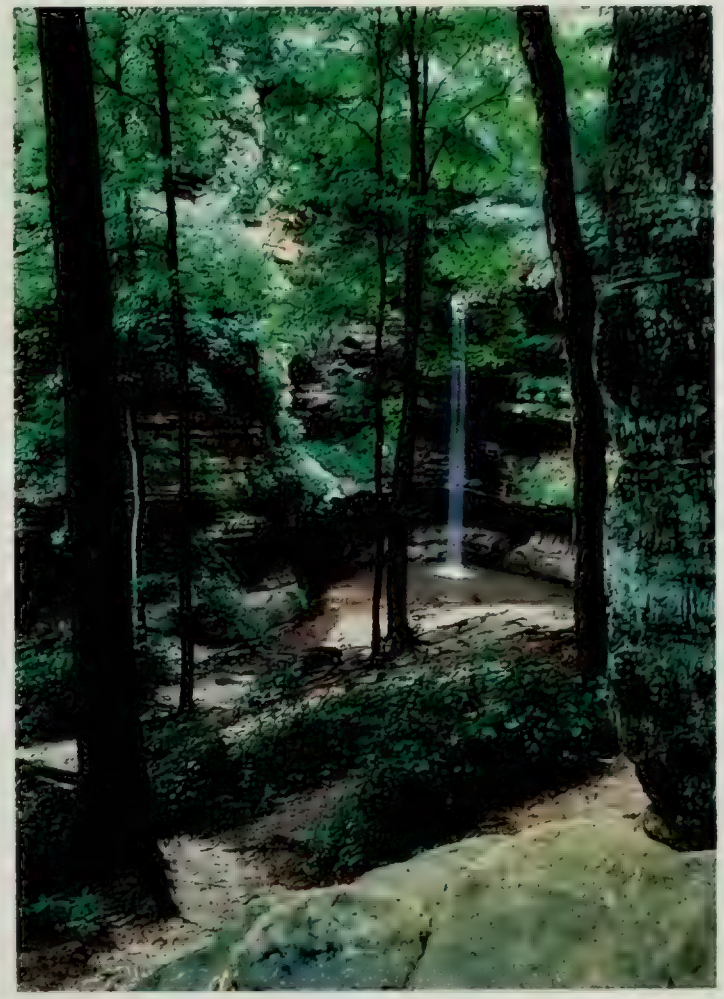
(continued on p. 32)

THREADS OF WILDERNESS

by Susan Post

The National Heritage Corridor of the Illinois and Michigan Canal extends from Chicago to LaSalle/Peru, a distance of over 100 miles, and encompasses some 450 square miles of the industrial heartland and prime farmland of Illinois. Quarries, cornfields, and refineries rest upon the dolomite and St. Peter's sandstone of the Des Plaines and Illinois River Valleys. Here, during early settlement times, the northern forests ended and the prairie began. Settlements along the canal were mere pinpoints dotting the prairie, forests, and wetlands.

Today the situation is reversed, and remnants of wilderness are pinpoints among the urban and agricultural sprawl. Within the National Heritage Corridor are eight state parks and at least 39 significant natural areas. Even after extensive development, this area retains one of the richest concentrations of natural areas and open lands in the entire state, providing clues to what once was here.



Starved Rock (Photo by the Illinois Department of Commerce and Community Affairs)

The Des Plaines River Valley

"From Chicago we made an excursion into the prairies...As we proceeded, the scenery became more and more like what all travelers compare it to - a boundless English park. The grass was wilder, the occasional footpath not so trim, and the single trees less majestic; but no park ever displayed anything equal to the grouping of the trees within the windings of the blue, brimming river Aux Plaines (Des Plaines)," recorded Harriet Martineau, while traveling from Chicago to Joliet in 1834.

The Des Plaines River Valley, between Willow Springs and Joliet, is a 20-mile valley segment enclosed by dolomite bluffs. At the end of the Wisconsinan glacial period, it was the outlet for glacial Lake Chicago. The large volume of water that poured through the wide area eroded through the glacial deposits to the bedrock, carved bluffs 50 feet in height, deposited low gravel ridges, and left an extremely shallow soil containing elements from the dolomite bedrock. A variety of habitat conditions favored the development of several diverse communities - wet and mesic prairies, marshes, and fens.

Today several state and federal threatened and endangered plant species are found here, including the leafy prairie clover, slender sandwort, white ladies slipper, and grass pink orchids. Periodic prairie fires blown from the west prevented the development of woods on the west bank of the Des Plaines. But on the east bank, insulated by the river from prairie fires, numerous oak groves are found.

Deer and furbearers abound. Even the beaver, which by the early 1900s was nearly exterminated from the state, can be found here. The river valley flyway supports over 200 species of birds, even a heron rookery in an old quarry. Visitors along the Canal often see an egret or heron flying overhead or fishing in wet, marshy places.

The natural beauty of the river valley is easy to overlook. Often all that is seen are oil refineries, tank farms, quarries, barges, and heavy trucks. Ironically, this same industry was an unwitting steward of nature throughout the valley. Within their fences and holdings, the factories protected much of the land.

Calcareous prairies on shallow limestone soils have almost completely disappeared from the Middle West. Even in presettlement days they were not very common. Most sites that supported this type of prairie were either destroyed by quarrying for flagstone or mining for gravel.

According to John Taft, research biologist for the Illinois Natural History Survey, portions of the glacial meltwater swept beaches along the Des Plaines River. Historically these may have contained naturally occurring dolomite glades or barrens, but all have been disturbed by human activity.

Plains pocket gopher, Goose Lake Prairie

Surprisingly, on intermittently wet rock surfaces that have been shallow-quarried for flagstone, glade habitats have been recreated. Such rare plants as slender sandwort and tufted hair grass have found a home here.

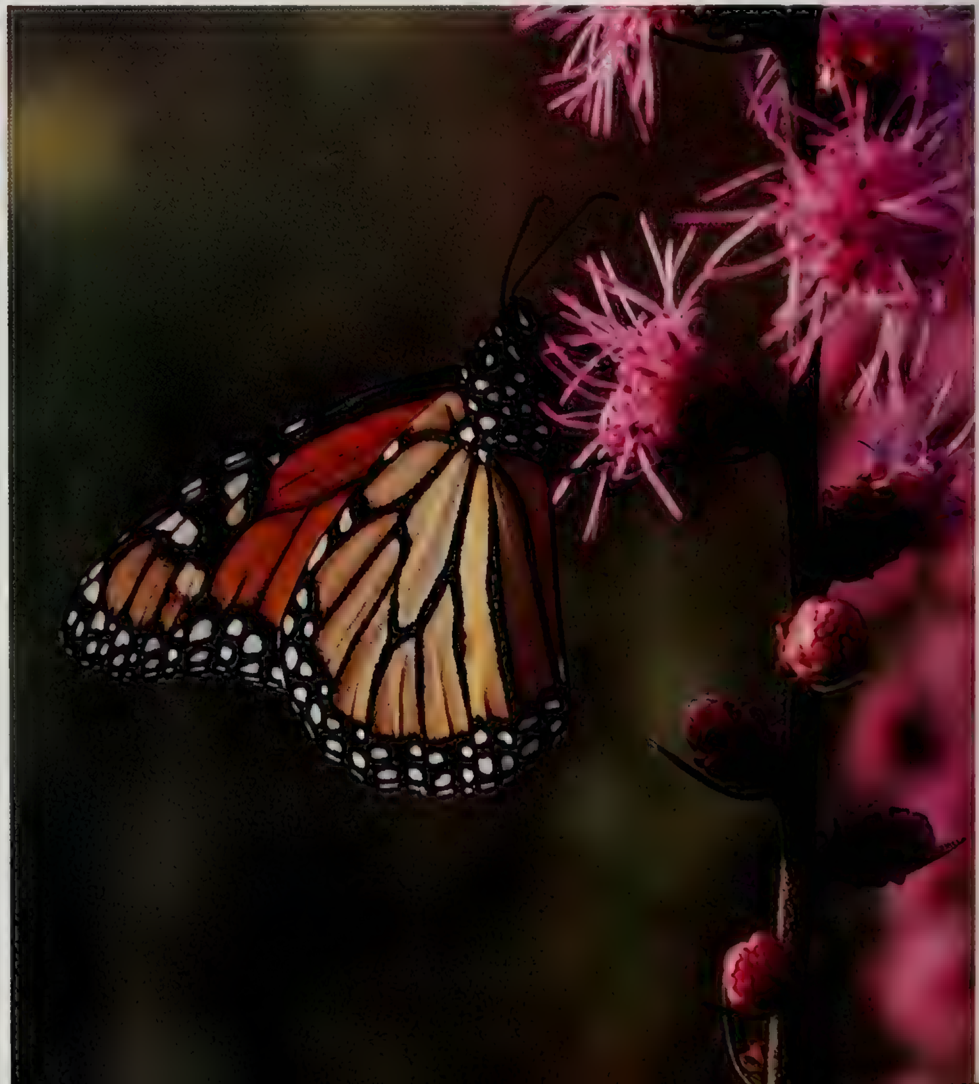
A few of the many other significant natural areas along the Des Plaines River section of the Heritage Corridor include Long Run Seep, which has spectacular displays of wildflowers in late summer and early fall. Black Partridge Woods, an upland oak forest, supports a rich spring flora, especially along the slopes and terraces of the seep spring runs. Sagawau Canyon, a dolomite canyon and cliff community, supports many plants common only much farther north.

Bluffs, Canyons and Prairies

"At about nine a.m., we reached the small town...called Morris...I can readily believe that it abounded in game. Morris is surrounded by fine prairies...Towards the afternoon we arrived at Ottawa: the town is situated in the most beautiful portion of the valley, which is formed by the high bluffs, which are here separated from each other about two miles...From Ottawa to LaSalle...rocky islands occasionally present themselves, now surrounded by fertile prairie and cornfields, which were, no doubt, formerly encircled by the stream." So Arthur Cunynghame reported in 1850, journeying on the Illinois and Michigan Canal.

The surface of much of northern Illinois is a nearly level, strikingly uniform, treeless upland. The upper Illinois River Valley is a relatively narrow trench; the valleys of its tributaries are even smaller notches. Both up and downstream from Starved Rock State Park the sides of the valley become steeper and steeper. The town of Morris lies in a low basin. The Seneca Valley has well-defined sides. At Ottawa, bedrock is exposed here and there and cliffs appear, only to become higher and higher, until at Starved Rock the sides of the Illinois River Valley are mostly cliffs of bare rock.

The topography of the region is most often associated with outcrops of St. Peter's sandstone. The valley floor is a floodplain with many permanently wet bottom tracts. Sloughs and seeps are numerous. Deserted river channels form long and sinuous depressions filled with material ranging from fine silt to gravel.



Monarch on blazing star

Purple prairie clover and rattlesnake master at Goose Lake

The diversified bluffs and canyons of the Illinois River Valley are but minor irregularities in the general upland prairie surface. Originally the prairie extended to the valley blufftops. Only a few miles from the river, the prairies were smooth and even the slight swells and swales were unnoticeable. The first settlers found the upland covered with tall grass, an almost endless sea of green and brown. Trees and shrubs were confined to the water courses.

At one time these prairies were reputed to have an unhealthful character. The earliest settlement in LaSalle was broken up by "fever and ague", and malarial ills were the bane of the pioneer prairie farmer. "Poisonous miasmas" were said to rise from the prairie because much of the land was poorly drained and contained foul swamps and stagnant pools.

The settlers persisted and agriculture somehow gained a toehold. When the prairie vegetation was cut, corn was usually the first crop planted in the half-rotted soil, often tilled by gashing it with an ax. The heavy prairie soil grew corn with better success than any other crop. Until the sod decomposed, small grains were difficult to raise.

Prior to the building of the Canal, corn was grown only for home consumption. The bulkiness of corn made it difficult to transport and thus unprofitable. Wheat was the chief cash crop of the early prairies. After the construction of the Canal, corn acreage increased and the growing of wheat was almost abandoned. Cheaper freight costs were an incentive to cultivate larger areas, and the vast expanses of prairie soon disappeared.

Goose Lake and Gebhard Woods

The largest prairie remnant in Illinois is Goose Lake Prairie, near Morris. Goose Lake is a place of grasses, wildflowers, and ceaseless prairie winds. Once it was home to the buffalo, wolf, prairie chicken, and otter. Huge boulders scattered in the area are evidence of its geologic history. These boulders were not formed in Illinois but were brought down from the north by glaciers over 10 thousand years ago.

Goose Lake itself no longer exists but was drained before the turn of the century for farming and to mine the underlying clay. In its day the lake was one thousand acres in extent, often covered so thickly with geese and ducks that the water was not visible. Today what remains of the lake is a series of ponds and marshes, outstanding examples of the once common prairie pothole.

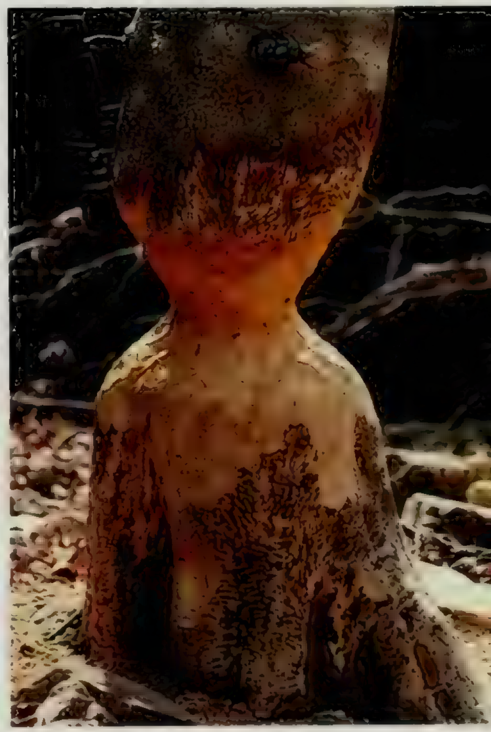
Amid the golden grasses in this relatively small parcel of prairie, one can feel the vastness of the prairie and be touched by the past. Waterfowl still feed here. Rabbits, muskrats, deer, and small rodents are everywhere abundant. The plains pocket gopher moves prodigious quantities of the better drained soils. Over 200 species of plants grow here.

Although the prairie was the dominant vegetation, trees grew along water courses protected from prairie fires. The old Canal towpath at Gebhard Woods State Park is lined by impressive trees. Huge, pallid sycamores mark the water's edge. Old oaks, ash, and walnut trees have a fantastic spring understory of bluebells, phlox, trout lily and wild ginger. Even these giant trees pale in comparison to the state's largest tree, also found along the towpath. This eastern cottonwood stands 120 feet tall and has a circumference of thirty-two feet and three inches.

Starved Rock

To one satiated with the wide horizontal vistas of the Illinois landscape, the bare rock cliffs that form the towering walls of Starved Rock State Park afford relief. The habitats range from swamps to deserts. Here a domed or anticlinal structure of bedrock was brought to the surface.

Streams have cut across the anticline and sunk their channels to considerable depth, giving rise to narrow, blind canyons and cliffs surrounded by a closed canopy forest. Starved Rock and the adjacent canyons are eroded from porous St. Peter's sandstone. Water falling on the rock quickly soaks through, and the sandy surface remains essentially dry. The water later appears in seeps and sloughs at the base of the cliffs.



Beaver Activity, Starved Rock

Egret along Canal near Willow Springs

At least one third of all Illinois fern species are part of Starved Rock's flora. Liverworts grasp the canyon walls like moist fingers. Chipmunks cavort among the crevices and along the trails. An occasional groundhog appears, bound for its den with a mouthful of dry leaves.

An unusual aspect of the area is the presence of survivor species. When the glaciers receded, they left behind representives of a colder climate. Such survivors as harebells, reindeer lichen, yew, and mountain holly are hidden in the coolness amidst the craggy surfaces of the canyons.

During the early construction of the Illinois and Michigan Canal, limestone was discovered near Utica. Subsurface mining of this limestone created a huge cave covering several acres. Today this area is a state nature preserve and a federally designated critical habitat.

The old mine serves as a hibernaculum for five species of overwintering bats: little brown, Keen's, eastern pipistrelle, big brown, and the state and federally endangered Indiana bat. In 1986 and 1987 Gene Gardner, research biologist with the Illinois Natural History Survey, and James Garner, with the Illinois Department of Conservation, along with 40 volunteers, mapped the entire mine area and plotted the location of the bat colonies. Biennial surveys continue, and at last count, the bat population was 20 thousand individuals. Of those, nearly 400 were the endangered Indiana bat.

Working for Preservation

One of the chief mandates of the legislation creating the National Heritage Corridor is to encourage conservation efforts. The Corridor Commission has been active in recognizing and preserving the unique flora and fauna found along the Canal.

Success stories abound. The Forest Preserve District of Will County recently passed a $50 million bond issue, of which $45 million will be used to acquire new land. The Lemont Village Canal Committee is currently developing a park to be called the General Fry Landing. Lake Renwick Heron Rookery was acquired and is now a nature preserve due to the efforts of the Forest Preserve District of Will County, the Illinois Nature Conservancy, the Illinois Department of Conservation, the Upper Illinois Valley Association, the Audubon Society of Illinois, and the Chicago and Will County Audubon Societies.

Perhaps the greatest success of all is the progress that has been made in the public's awareness of the value of natural lands. With the cooperation of many, the threads of wilderness that exist like capillaries along the vein of development that is the Illlinois and Michigan Canal will continue to exist far into the future. ■

Susan Post is an Assistant Research Biologist at the Center for Biodiversity in the Illinois Natural History Survey.

A GUIDE TO THE ILLINOIS AND MICHIGAN CANAL

MUSEUMS AND VISITORS CENTERS

Blue Island Historical Society
2433 York Street
Blue Island, IL
708/388-1078

Community Center Foundation
Children's Farm and Nature Center, 12700 Southwest Highway
Palos Park, IL 60464
708/361-3650

Little Red Schoolhouse Nature Center
Cook County Forest Preserve
P.O. Box 92, 104th Avenue between 95th and 107th Streets
Willow Springs, IL 60480
708/839-6897

Lemont Area Historical Society Museum
303 Lemont Street, P.O. Box 126
Lemont, IL 60439

Isle a la Cache Museum
501 Romeo Road
Romeoville, IL 60441
815/886-1467

Will County Historical Society Museum
803 South State Street
Lockport, IL 60441
815/838-5080

I&M Canal Visitor Center
The Gaylord Building
200 West Eighth Street
Lockport, IL 60441
815/838-4830

Enjoying the Canal

Will-Joliet Bicentennial Park
201 West Jefferson at Bluff Street
Joliet, IL 60435
815/740-2216

Joliet Area Historical Society Museum
17 East Van Buren
Joliet, IL 60431
815/722-7003

Pilcher Park Nature Center
Off East Cass Street
(U.S.Route 30)
Joliet, IL 60435
815/741-7277

I&M Canal State Trail-Gebhard Woods Access
Post Office Box 272,
Ottawa Street
Morris, IL 60450
815/942-0796

Goose Lake Prairie State Natural Area
5010 N. Jugtown
Morris, IL 60450
815/942-2899

Grundy County Historical Society Artifact Displays
Grundy County Courthouse,
Washington & Liberty
Morris, IL 60450

Illinois Waterway Visitor Center
Route 1, Dee Bennett Road
Ottawa, IL 61350
815/667-4054

LaSalle County Historical Society Museum
Route 178 & I&M Canal
Utica, IL 61373
815/667-4861

Starved Rock State Park
P.O. Box 116,
Utica, IL 61373
815/667-4906

CULTURAL TREASURES

Visitors can discover a kaleidoscopic mingling of French trappers' sites, early Canal towns, and 19th century American cultures throughout the Corridor. Numerous museums, festivals, and historic sites bring this rich heritage to life.

St. James of the Sag Church and Graveyard
A parish since 1833, this native limestone church in Lemont dates from the 1850s. Canal workers' graves here date to 1846.
708/257-7000

Argonne National Laboratory
Argonne is one of the nation's leading scientific research facilities.
9700 S. Cass Avenue
Argonne, IL 60439
708/972-5575

Mother Theresa Home
Shrine to Mother Theresa is housed in the Walker limestone mansion. 1270 Main Street
Lemont, IL 60439
708/257-5801

Illinois State Museum-Lockport Gallery
The Gaylord Building
200 West Eighth Street
Lockport, IL 60441
815/838-7400

Illinois & Michigan Canal Recreational Historical Trail System
Two-mile trail with markers interpreting various historic sites in this 1837 Canal town, including I&M Canal Lock No.1 and the Norton and Gaylord Buildings.

Rialto Square Theatre
A 1926 Rapp & Rapp vaudeville movie palace, the Rialto was restored in 1981 and presents many major national and international performances.
102 N.Chicago Street,
P.O.Box 792
Joliet, IL 60434
815/726-6600

Chief Shabbona's Grave

The grave of this Potawatomi chief can be seen in Morris. His friendship with the settlers was of immense importance during the Black Hawk War. His warnings about impending attacks saved lives and property.

Reddick Mansion

An 1856 Italianate mansion, Reddick Mansion overlooks the site of the first Lincoln-Douglas debate and has been restored as a period museum and office.
100 W. Lafayette
Ottawa, IL 61350
815/433-0084

Washington Park

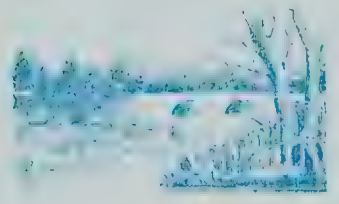
Where Lincoln and Douglas held their first debate.
Rte. 6
Ottawa, IL 61350
815/433-0084

Overlook Park

Small park and shelter overlook breathtaking view of Ottawa Silica's Company silica sand mining operation.
Boyce Memorial Drive
Ottawa, IL 61350
815/434-0190

Lock No. 14, Illinois and Michigan Canal

This lock was restored in 1983 to its 1848 working condition. It is representative of mid-nineteenth century canal locks.
Canal Street and Route 351
LaSalle, IL 61301



DEDICATED NATURE PRESERVES

The Illinois and Michigan Canal National Heritage Corridor contains some 39 rare natural areas, remnants of the ancient Illinois landscape. Several of these are dedicated Illinois Nature Preserves, of which the following have public access. These are fragile areas not intended for recreational use, so please exercise care and caution.

Cranberry Slough

96th Avenue,
Palos Division, Cook County
Forest Preserve
708/839-5617

Paw Paw Woods

Archer Avenue,
Palos Division, Cook County
Forest Preserve
708/839-5617

Sagawau Canyon

Route 83,
Palos Division, Cook County
Forest Preserve
708/839-5617 By appt. only

Black Partridge Woods Nature Preserve

Bluff Road, Lemont
Cook County Forest Preserve
708/839-5617

O'Hara Woods

Beverly Griffin Drive
Romeoville
815/886-7237

Lockport Prairie

Route 53 and Division Street
Lockport, Will County
Forest Preserve
815/727-8700

Grant Creek Prairie

Des Plaines Conservation Area,
Will County
815/423-5326

Goose Lake Prairie

Goose Lake Prairie State
Natural Area
Morris
815/942-2899

Starved Rock Nature Preserve

Starved Rock State Park
Utica
815/667-4726

ILLINOIS WATERWAY LOCKS AND DAMS

Visitors can watch modern shipping at work as barges are locked in and out at these Illinois Waterway locks and dams.

Thomas J. O'Brien Lock and Dam

134th Street and Calumet River
Chicago, IL 60633

Lockport Lock and Dam

Lockport, IL 60441

Brandon Road Lock and Dam

Rockdale, IL 60421

Dresden Island Lock and Dam

Morris, IL 60450

Marseilles Lock and Dam

Marseilles, IL 61341

Illinois Waterway Visitor Center

Starved Rock Lock and Dam
Dee Bennett Road at Route 178

RECREATION: Parks and Trails in the I&M Canal Corridor

Parks and trails are organized into three categories: State and Local Parks and Conservation Areas, Forest Preserve Holdings, and Canoe Trails. For more specific information on facilities, please call ahead.

State & Local Parks, Fish & Wildlife, Conservation Areas

Des Plaines Conservation Area

R.R. 3, Box 167
Wilmington, IL 60481
815/423-5326

Dellwood Park

Route 171
Lockport
815/838-1183

Illinois & Michigan Canal State Trail

The I&M Canal State Trail is a linear park comprising the canal prism and 60 miles of trail used for hiking and biking. Access points are at Channahon, Gebhard Woods, William G. Stratton and Buffalo Rock State Parks and the I&M Canal in Utica and at Lock No. 14 at LaSalle.
815/942-0796

Lock No.6 and lockkeepers house near Channahon

Channahon Access (I&M Canal State Trail)

Canal Street
Channahon 60410
815/462-4271

Goose Lake State Natural Area

5010 N. Jugtown
Morris 60450
815/942-2899

Heidecke State Fish & Wildlife Area

(Collins Lake) 5010 N. Jugtown
Morris 60450
815/942-6352

William G. Stratton State Park

Box 272
Morris 60450
815/942-0796

Gebhard Woods Access (I & M Canal State Trail)
Box 272
Morris 60450
815/942-0796

Illini State Park
R.R. 1, Box 4
Marseilles 61341
815/795-2448

Buffalo Rock State Park
Box 39
Ottawa 61350
815/433-2224

Matthiessen State Park
Box 381
Utica 61373
815/667-4868

Starved Rock State Park
Box 116
Utica 61373
815/667-4726

Forest Preserve Holdings

Cook County Forest Preserve District
536 N. Harlem
River Forest 60305
708/366-9420

Chicago Portage Woods
Harlem Avenue near I-55
708/366-9420

Arie Crown Forest
17th & Salt Creek
North Riverside
708/447-0090

Palos Forest Preserve
104th Avenue between 95th &
107th Streets
708/839-5617

Black Partridge Woods
McCarthy Road east of
Will-Cook Road
Lemont
708/448-8532

DuPage County Forest Preserve District
P.O. Box 2339
Glen Ellyn 60138
708/790-4900

Waterfall Glen
Bluff Road
Lemont 60439
708/790-4900

Will County Forest Preserve District
Rt. 52 & Cherry Hill Road
Joliet 60433
815/727-8700

Veterans Woods
Keepataw Woods
Runyon Preserve
Lockport Prairie
Lambs Woods
Lake Renwick Heron Rookery
815/727-8700

Isle a la Cache
501 East Romeo Rd.
Romeoville 60441
815/886-1467

McKinley Woods
815/727-8700

Canoe Trails

Chicago Portage Canoe Trail
A 14.4-mile canoe trail beginning in Cook County at Stony Ford and ending in Lemont.
708/366-9420 or 708/261-8400

I&M Canal NHC Canoe Trail
Under development.
815/727-8700

DuPage River Canoe Trail
Access at Hammel Woods and McKinley Woods.
Will County Forest Preserve.
815/727-8700

Norton Warehouse, Lockport

Old I&M Canal Canoe Trail
A 15.15 mile canoe trail from Channahon to Morris; access at McKinley Woods and also Aux Sable
815/942-0796

Old I&M Canal Canoe Trail
A 4.6 mile canoe trail from Utica to Lock # 14
LaSalle
815/942-0796

PLACES TO DISCOVER

Each of the communities in the Corridor has a special identity and a story unique to its past and present. For further information about the towns and about special events, festivals and other local celebrations, telephone or visit one of the Corridor Visitor Centers.

Blue Island
Founded 13 years before the Canal opened, Blue Island became home to British, German, Italian, Scandinavian, Hispanic, and Slavic immigrants. The town's historical society maintains a display in the public library.

Bridgeport
On July 4, 1836, Bridgeport was the scene of great excitement as a ground-breaking officially marked the beginning of construction on the Illinois and Michigan Canal.

Lyons
In September, 1673, French explorers Marquette and Jolliet arrived at a small stream known as Portage Creek. At this point they carried - portaged - their canoes across open prairies to the south bank of the Chicago River. For centuries this site was an intersecting point for land and water routes. It was a crossroads of travel for Native Americans, French fur traders, and ultimately for American pioneers. Today this area is known as the Chicago Portage National Historic Site. A 300-acre park, part of the Cook County Forest Preserve District, preserves this site and adjacent lands.

Summit
This is the site that intrigued Jolliet more than 300 years ago. On one side of the dividing point, water flows toward the Atlantic Ocean; on the other side water flows toward the Mississippi River and the Gulf of Mexico. Near Summit was an ancient mud lake that filled wth water and overflowed seasonally. Indians and traders tried to time their travels to take advantage of these overflows in order to journey in their canoes to or from Lake Michigan.

Lemont
On the outskirts of this small Canal town is St. James of the Sag, a church built in the mid-nineteenth century with limestone found in the Corridor. Irish immigrants who worked on the Canal were buried in the church's cemetery. The Lemont Area Historical Society Museum is housed in the Old Stone Church. A highway bridge pedestrian walkway provides a spectacular view of the Des

Plaines River, the Chicago Sanitary and Ship Canal, the Illinois and Michigan Canal, and a major railroad line.

Argonne National Laboratory, one of the nation's leading research facilities, is located just outside Lemont.

Romeoville

This Canal town offers visitors opportunities to review and experience typical activities of French traders and trappers during the fur trade era. Visit the Isle a la Cache Museum to see special exhibits about the region. Interpretive tours help to recreate the adventures of these pioneers as they traveled the wilderness of Illinois more than a century ago.

Lockport

This Canal town is considered one of the best preserved Canal towns in existence today. Its historic district, bounded by the Canal, 7th Street, Washington Street, and 11th Street, offers no less than 37 historic sites and structures.

Historical sites in Lockport that deserve special attention: *Lock No. 1*, the first lock built on the I&M Canal. *The I&M Canal Office*, the original headquarters for the Canal Commissioners, now *the Will County Historical Society Canal Museum. The Gaylord Building. Lockport Historic Trail*, a walk along the Canal towpath to Lock No. 1 and Dellwood Park. The trail's signs interpret key aspects of Canal activities. *Lockport Prairie*, part of a prairie which once covered the entire region, includes prairie grass, wildflowers, and wildlife side by side with modern industrial facilities.

Joliet

This Canal town is the site of the Rialto Square Theatre, restored to the opulent grandeur of the twenties. It houses hundreds of original sculptures and the largest handcut crystal chandelier in the United States. In addition to the Rialto Theatre, Joliet's other places of historical interest include Joliet Central High School, the Old Illinois State Penitentiary, and Brandon Road Lock. The city is the site of the Will-Joliet Bicentennial Park, a performing arts center, Pilcher Park Nature Center, and the Joliet Historical Society Museum.

Channahon

At Channahon Access, visitors can walk a trail following the Canal towpath, sensing the time more than a century ago when the path yielded under the hooves of countless mules towing heavy barges and canal boats. The Park is the locale of the DuPage River Dam, Locks 6 and 7, and a restored locktender's house. The building is used today as a home for the Park Ranger.

Morris

At Lock No. 8, east of this Canal town, the Canal's waters flow quietly past the Aux Sable locktender's house as they once flowed under the Canal's boats. Here is also located one of the Canal's engineering accomplishments, the Aux Sable aqueduct. This structure was built to carry the Canal over a stream and keep the level of Canal water constant. A visit to this bridge of water is enhanced by the way it sits almost in isolation, back from the road and surrounded by trees, an oasis of tranquility.

Gebhard Woods Access is the headquarters for the Department of Conservation's Illinois and Michigan Canal State Trail. Also located in the Park is a Corridor Information Center and Nettle Creek Aqueduct. The biggest tree in Illinois, an Eastern cottonwood, still grows in this Park. The William G. Stratton State Park, a popular boat launching facility on the Illinois River, is located in Morris. These parks offer visitors both scenic and active recreation.

Seneca and Marseilles

These are typical of smaller Canal towns. The Illini State Park lies near Marseilles and offers a beautiful view overlooking the Illinois River.The scene also provides an interesting historical sidelight as one compares the large twentieth century boats passing through the Illinois River Marseilles Lock to an imaginary Canal boat passing through the small I&M Canal locks. Seneca also features an 1861 grain elevator.

Ottawa

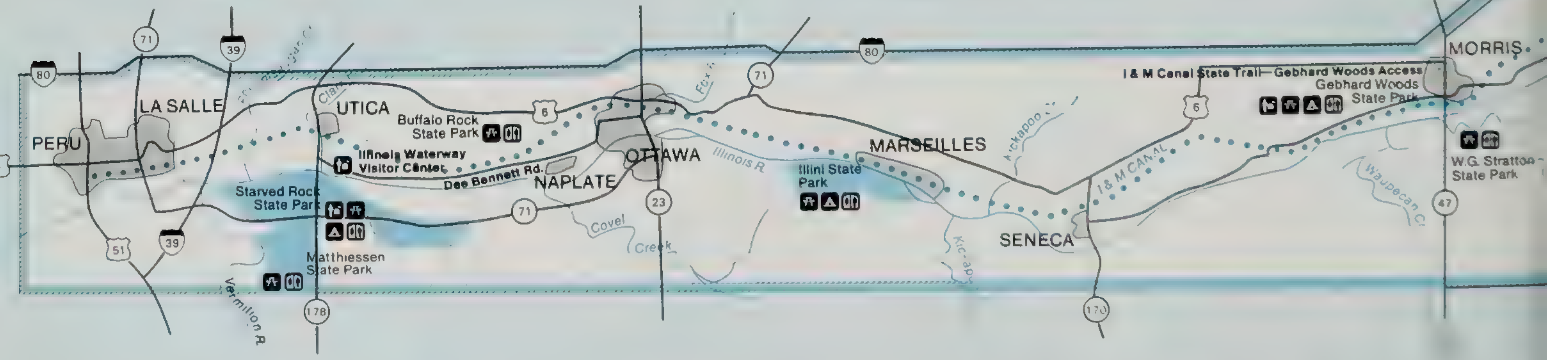
History buffs will love Ottawa as a watershed site of Americana, for here is where Abraham Lincoln and Stephen Douglas began the debates that helped decide the 1858 senatorial campaign and provided Lincoln with national prominence. A memorial commemorating the first debate is the centerpiece of Washington Park. Other historic landmarks are Reddick Mansion, across from the Park, and a memorial to W.D. Boyce, the founder of the Boy Scouts of America. Boyce was a resident of the city and is buried in Ottawa Avenue Cemetery.

The Effigy Tumuli in Buffalo State Park are a remarkable example of monumental art. Five earth effigies (or tumuli) - a snake, turtle, catfish, frog, and water strider - were built on a sandstone bluff overlooking the Illinois River Valley.

Utica

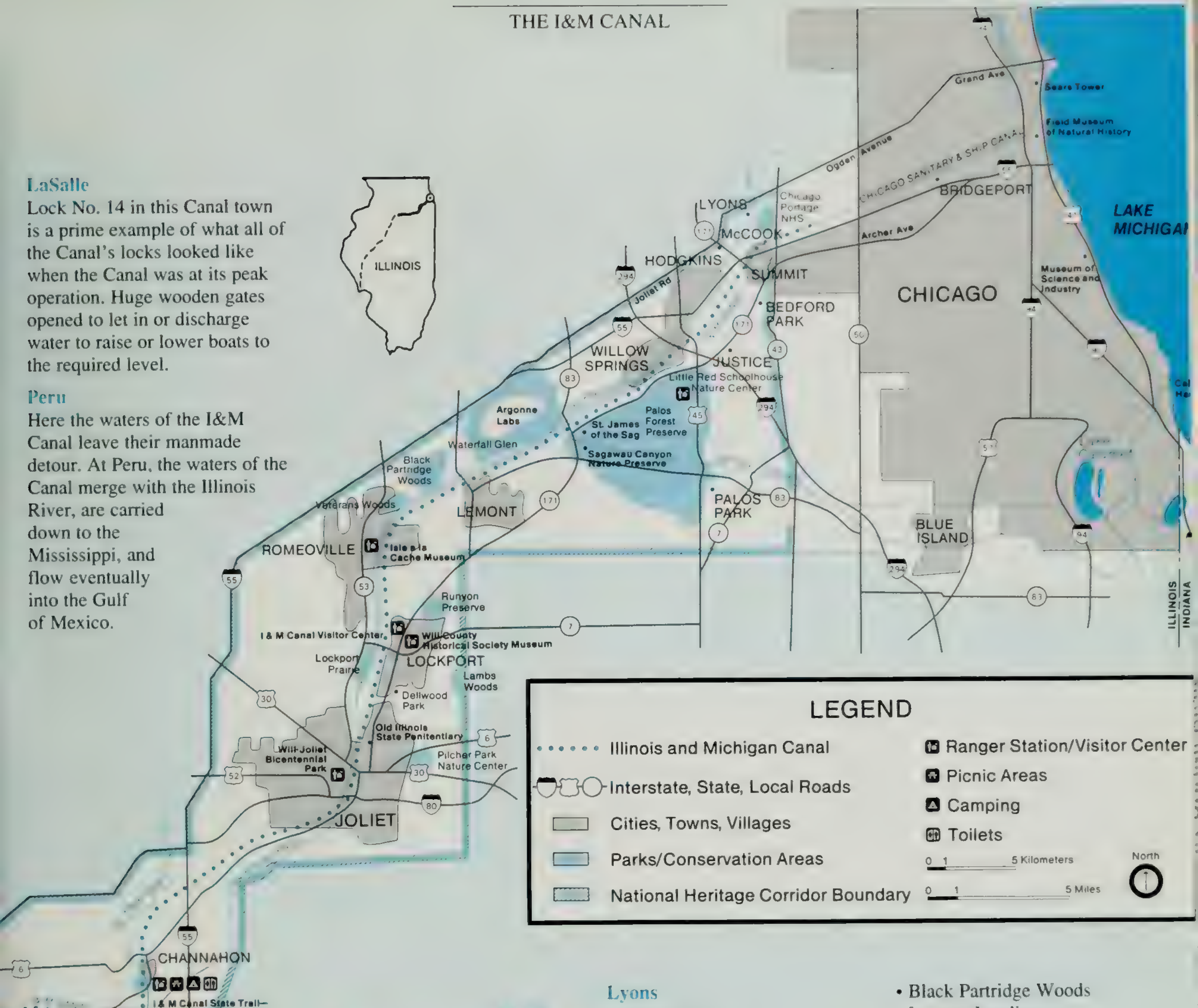
The LaSalle County Historical Society is located in one of the Canal-front warehouses once intended to serve the people operating and traveling on the Canal. Its exhibits include artifacts and displays interpreting the history of the Canal. Halfway House, a historic landmark, is on the outskirts of Utica, near Ottawa.

Starved Rock, with many hiking trails, and Matthiessen State Park located just south of Utica offer visitors opportunities to see a wide variety of plant life and wildlife. The Illinois Waterway Visitor Center houses a major exhibit on the I&M Canal and the 20th Century Waterway system.



LaSalle
Lock No. 14 in this Canal town is a prime example of what all of the Canal's locks looked like when the Canal was at its peak operation. Huge wooden gates opened to let in or discharge water to raise or lower boats to the required level.

Peru
Here the waters of the I&M Canal leave their manmade detour. At Peru, the waters of the Canal merge with the Illinois River, are carried down to the Mississippi, and flow eventually into the Gulf of Mexico.


ILLINOIS
LAKE MICHIGAN
Sears Tower
Field Museum of Natural History
Museum of Science and Industry
Grand Ave
Ogden Avenue
CHICAGO SANITARY & SHIP CANAL
BRIDGEPORT
Archer Ave
CHICAGO
LYONS
Chicago Portage NHS
McCOOK
HODGKINS
SUMMIT
Joliet Rd
BEDFORD PARK
JUSTICE
WILLOW SPRINGS
Little Red Schoolhouse Nature Center
Argonne Labs
Palos Forest Preserve
St. James of the Sag
Sagawau Canyon Nature Preserve
Waterfall Glen
Black Partridge Woods
Veterans Woods
LEMONT
PALOS PARK
BLUE ISLAND
ROMEOVILLE
Isle a la Cache Museum
Runyon Preserve
I & M Canal Visitor Center
Will County Historical Society Museum
LOCKPORT
Lockport Prairie
Lambs Woods
Dellwood Park
Old Illinois State Penitentiary
Will-Joliet Bicentennial Park
Pilcher Park Nature Center
JOLIET
CHANNAHON
I & M Canal State Trail—Channahon Access
McKinley Woods
Des Plaines Conservation Area
Lake State Area
ILLINOIS
INDIANA
294
55
83
171
43
45
50
53
7
30
52
6
80
94
LEGEND
Illinois and Michigan Canal
Interstate, State, Local Roads
Cities, Towns, Villages
Parks/Conservation Areas
National Heritage Corridor Boundary
Ranger Station/Visitor Center
Picnic Areas
Camping
Toilets
0 1 5 Kilometers
0 1 5 Miles
North

POINTS OF INTEREST

Chicago
- Field Museum of Natural History
- Art Institute
- Museum of Science and Industry
- Shedd Aquarium
- Sears Tower

Blue Island
- Blue Island Public Library and Historical Society Museum

Lyons
- Stony Ford
- Chicago Portage

North Riverside
- Arie Crown Forest

Palos Park
- Columbia Woods
- Children's Farm and Nature Center

Willow Springs
- Little Red Schoolhouse Nature Center

Lemont
- St. James of the Sag Church and Cemetery
- Argonne National Laboratory
- Lemont Area Historical Society Museum
- Waterfall Glen
- Black Partridge Woods
- Lemont Landing

Romeoville
- Isle a la Cache Museum
- Veterans Woods
- Romeoville Prairie Nature Preserve

Lockport
- Fitzpatrick House
- I&M Canal Visitor Center
- Norton's Mill
- Illinois State Museum-Lockport Gallery
- Will County Historical Society Museum and Pioneer Settlement
- Gaylord Building
- Lock No. 1
- Lockport Historical Trail
- Lockport Lock and Dam
- Dellwood Park

- Messenger Woods
- Runyon Preserve
- Lockport Prairie Nature Center
- Lambs Woods

Joliet

- Rialto Square Theatre
- Will-Joliet Bicentennial Park
- Joliet Central High School
- Old Illinois State Penitentiary
- Pilcher Park Nature Center
- Brandon Road Lock and Dam
- Joliet Area Historical Society Museum

Channahon

- I&M Canal State Trail - Channahon Access
- McKinley Woods
- Des Plaines Conservation Area

Morris

- I&M Canal State Trail - Gebhard Woods Access (Trail Headquarters)
- W.G. Stratton State Park
- Nettle Creek Aqueduct
- Biggest Tree in Illinois
- Goose Lake Prairie State Natural Area
- Heidecke State Fish and Wildlife Area
- Aux Sable Locktender's House
- Aux Sable Aqueduct
- Lock No. 8
- Grundy County Historical Society Artifacts Display
- Chief Shabbona's Grave

Seneca

- Old Grain Elevator

Marseilles

- Marseilles Lock and Dam
- Illini State Park

Ottawa

- Washington Park (site of Lincoln-Douglas debate)
- Reddick Mansion
- Fox River Aqueduct
- I&M Canal State Trail - Buffalo Rock Access
- Effigy Tumuli - Buffalo Rock Access

Utica

- Illinois Waterway Visitor Center
- Starved Rock State Park
- Matthiessen State Park
- LaSalle County Historical Society Museum
- Halfway House

LaSalle

- Lock No. 14
- Little Vermilion Aqueduct

ANNUAL HERITAGE FESTIVALS

October

Annual Pioneer Crafts Festival
815/838-5080
Lockport, Pioneer Settlement
Early American crafts, exhibits and demonstrations.

Burgoo Festival
Second weekend
815/667-4861
Utica, citywide. Enjoy settler's "burgoo" (stew), historic displays, rides, games.

November

Christmas Housewalk
Ottawa, Pitstick Pavillion

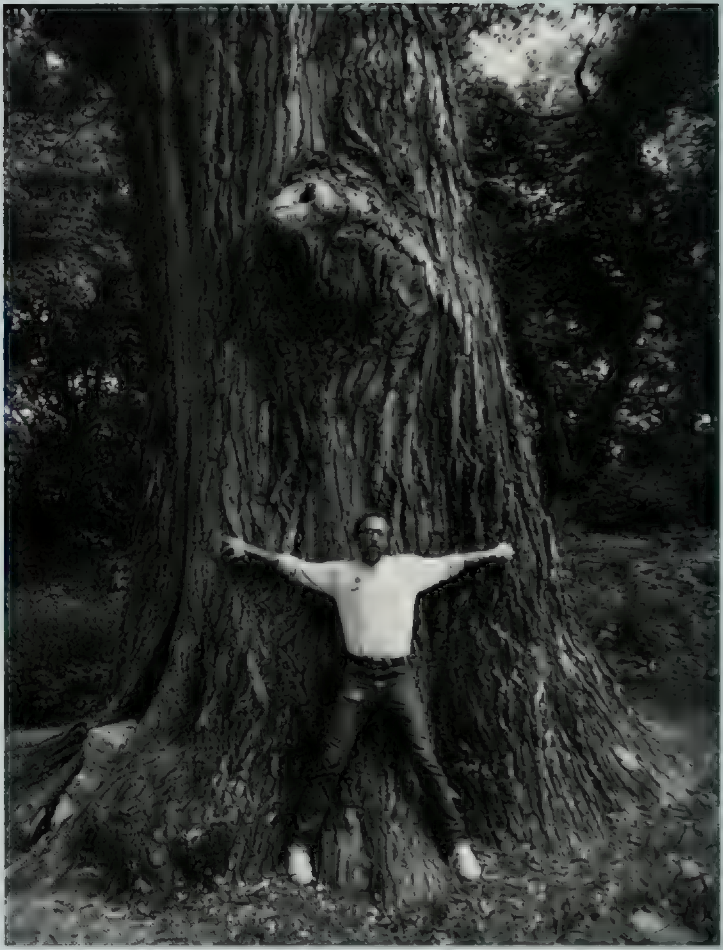
Christmas Crossroad
815/838-3357
Lockport, Lockport East High School.
One of the largest regional annual crafts fairs.

January

Winter Wilderness Weekend
815/667-4906
Utica, Starved Rock Visitor Center.
Guided hikes, cross-country skiing.

March

Spring Craft Show
815/223-7600
Downtown Peru
A variety of native and ethnic crafts & holiday decorations.



Eastern Cottonwood, largest tree in Illinois (Credit: Susan Post)

April

Will County Folk Art Festival
815/838-5080
Lockport, Pioneer Settlement
Heritage arts & crafts, music, folk dancing, exhibits.

May

Annual Wildflower Pilgrimage
815/667-4906
Utica, Starved Rock State Park
Guided hikes around park to view wildflowers.

A Taste of Joliet
late May/June
815/741-7275
Joliet, Memorial Stadium
Four days of food, carnivals, music.

June

Island Rendezvous at Isle a la Cache
815/886-1467
Romeoville, Will County Forest Preserve District, first Saturday
Annual gathering at Isle a la Cache of costumed enthusiasts recreating the annual meeting of the French and Indians for trade.

Summer Performing Arts Concerts
815/838-1183
Lockport, Dellwood Park Sun. eves. June, July & August Free outdoor concerts.

Concerts on the Hill
815/740-2216
Joliet, Bicentennial Park
Thursdays June, July & August
Free concerts at outdoor bandshell.

Annual Taste of the Illinois Valley
815/223-7904
Peru, Centennial Park
Ethnic food, rides, games, crafts, auctions, entertainment.

Montreal Canoe Weekends
815/667-4906
Utica, Starved Rock State Park
Voyageur canoe replica rides.

Old Canal Days
Third weekend
815/838-4744
Lockport, I&M Canal, Historic District, Central Square
Parade, arts & crafts, music, heritage shows, beer garden, games, food, historic tours, prairie tours, demonstrations of early American crafts, petting zoo, horse carriage rides, carnival, museum.

July

Dulcimer Festival
Second weekend
815/942-0796
Morris, Gebhard Woods Access
Features both hammered and mountain dulcimers, other stringed instruments.

Waterway Daze
Third weekend
815/740-2921
Joliet, Bicentennial Park, Bluff at Jefferson. Watercraft parade, food, live entertainment.

Friendly City River Fest
July-August
815/433-0084
Downtown Ottawa
Food, beer, ethnic music & dance, games, 10K run, parade and special events.

NOTE: Most Corridor communities have traditional American heritage celebrations on July 4, Independence Day.

August

Annual Channahon Three Rivers Fest
815/467-5361
Channahon, Sage & Bluff Sts.
Parade, carnival rides, games, beer garden, dancing.

Annual Keepetaw Days
708/257-6787
Lemont, 1200 Warner, Lemont Plaza
Carnival with live entertainment, rides, beer garden, food and Labor Day Parade.

LaSalle County Annual Folk Festival
815/434-5328
Ottawa, 4-H Club Fairgrounds
Family-oriented festival depicting farm and home life in the 1800s. Music, food, entertainment.

Founder's Day
815/886-6222
Romeoville, Romeoville Recreation Department
Parade, food, special events and fireworks.

September

Summit Ethnic Festival
708/563-4800
Summit, Summit Park (58th & Archer) Ethnic foods, beer garden, entertainment, children's games.

Turn of the Century Celebration
815/667-4906
Utica, Starved Rock State Park
German and Dixieland bands, horseshoes, high wheel bikes, hot air balloons, vaudeville show, paddlewheel steamboat rides in Illinois River, children's games.

Buffalo Rock Bluegrass Festival
815/942-0796
Ottawa, Buffalo Rock State Park
Second weekend
Features bluegrass and folk musicians.

I&M Canal Rendezvous
Mid-September
708/496-1890
Willow Springs, Columbia Woods, Cook County Forest Preserve
Festival brings together craftsmen and others recreating the fur trade era of American history.

Grundy County Corn Festival
815/942-2676
Morris. Last weekend
Displays of agricultural products and machinery, petting zoo, arts and crafts, photography, fireworks.

READ MORE ABOUT IT

There are several excellent books, guides and brochures for both researchers and laypersons interested in the Corridor and its history. These include:

The Illinois and Michigan Canal National Heritage Corridor: A Guide to Its History and Sources, edited by Dr. Michael Conzen and Kay Carr, Northern Illinois University Press, 1988. This invaluable volume gives an annotated description of source documents and repositories of archival material. Call NIU Press at 815/753-1826.

I&M Canal, A Corridor in Time, by John Lamb, Lewis University, 1987. A summary of the historical events and personalities that led to the digging of the Canal and its operations. Call Dr. John Lamb at Lewis University at 815/838-0500, ext.322.

The Corridor Journal is published by the Corridor Commission on a semi-annual basis. It includes a Calendar of Events as well as articles written by park staffs. Call the Corridor Commission at 815/740-2047.

Lincoln's Connections with the Illinois and Michigan Canal, by Dr. Wayne Temple, publisher Illinois Bell, 1986. This book details Lincoln's efforts as a state legislator to get the Canal built, as well as his travels on the Canal. Call the Corridor Commission at 815/740-2047.

An Inventory and Evaluation of Known Archaeological Resources in the Illinois and Michigan Canal National Heritage Corridor, Illinois, American Resources Group, Ltd., 1985. Call the Corridor Commission at 815/740-2047.

Ice Age Geology: Illinois and Michigan Canal National Heritage Corridor, Illinois State Geological Survey, 1989. Call the Corridor Commission at 815/740-2047.

The Corridor Commission has many more booklets, tour guides and other informational materials on the I&M Canal Corridor. Call them at 815/740-2047 for additional assistance.

A CORRIDOR'S PROGRESS: AN I&M CANAL CHRONOLOGY

1673
French explorer Jolliet recommends building a canal through a low divide separating the Chicago and Des Plaines Rivers.

1835
The second Illinois Canal Commission is created by the State of Illinois and successfully raises money.

1836
Construction begins on the Canal on July 4.

1848
The I&M Canal officially opens its locks. The Midwest's hub moves to Chicago from St. Louis.

1854-1900
Advent of the railroad and decline of Canal traffic.

1982

Upper Illinois Valley Association and Friends of I & M Canal are formed to promote the Corridor concept.

1984

The President signs the bill recognizing the I&M Canal as the first National Heritage Corridor on August 24.

Groundbreaking for two-and-one-half mile recreational and interpretive I&M Canal Trail in Lockport. Interns from the University of Chicago scour the 120-mile Corridor system preparing the first bibliography of the Corridor's historical materials.

Michael Heizer begins work on his *Effigy Tumuli*, huge animal earth sculptures on land acquired by the Ottawa Silica Company.

The State of Illinois announces new funds for the Corridor, including the I&M Canal State Trail and Starved Rock State Park.

1985

Blue Island Historical Society opens Local History Room at Public Library.

Effigy Tumuli earth sculptures formally dedicated.

1986

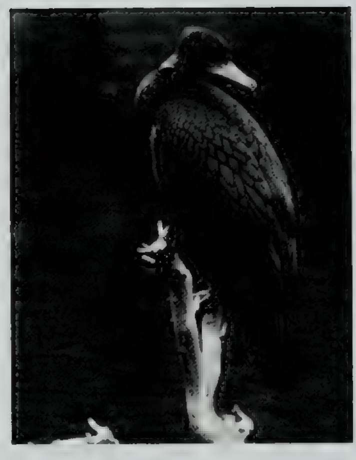
Executive Director Lee Hanson hired to staff Corridor Commission. National Park Service details first Interpretive Specialist for the Corridor.

Illinois resurfaces three miles of towpath and dredges portions of Canal near Utica and Seneca.

Corridor Commission and Illinois Department of Conservation (IDOC) enter into agreement to rehabilitate structures on the Canal. Lock No. 1 rehabilitated at Lockport and archaeological work done there.

Training completed for 27 volunteer interpreters at 11 sites.

The Gaylord Building restoration to 1860s appearance completed and opened to public with state visitors center, Illinois State Museum Gallery and private restaurant.



Double-crested cormorant at Lake Renwick

4.1 million visitors come to the Corridor's major attractions.

1987

Illinois Department of Conservation restores Aux Sables Aqueduct and Lock No. 14, surfaces hiking/biking trail through Ottawa. Pumpway and spillway in Utica-Marseilles area installed to relieve stagnation in Canal.

Brochures for Corridor and *A Corridor in Time* published. Signage put up on major interstates.

300th anniversary of death of Robert Cavalier de LaSalle celebrated at Starved Rock.

Several Corridor towns, laid out and established by the Canal Commission in 1837, celebrate their sesquicentennials.

Seven visitor centers established by Corridor at existing facilities.

Corridor is designated Economic Corridor of Opportunity by State of Illinois, making it eligible for tourism and marketing funds.

Ribbon-cutting at Gaylord Building by Governor Thompson.

Economic Development Agency of U.S. Department of Commerce gives $419,000 grant to Commisssion for Revolving Loan Fund to encourage economic revitalization.

Corridor visitation increases to 4.4 million during 1987.

1988

Friends of the I&M Canal sponsor major cleanup of Canal.

First National Conference on Historic Canals co-sponsored by Friends of the I&M Canal and IDOC.

Starved Rock State Park Lodge refurbishing completed.

Metropolitan Water Reclamation District of Greater Chicago establishes 26-mile trail between Chicago Portage site in Chicago and Lockport. New trails added and others upgraded.

Farm east of Lockport recognized as oldest farm in Corridor; oldest industry in Corridor is Joliet Steel Mill.

Corridor communities hold ethnic festivals.

Five boat tours of northeast portion of Corridor waterways are conducted by Upper Illinois Valley Association.

Ice Age Geology of I&M Canal Corridor published by Illinois State Geological Survey.

Illinois legislature appropriates funds for restoration of Reddick Mansion.

Gaylord Donnelley, guiding force behind restoration of Gaylord Building, one of ten individuals honored nationwide by President Reagan for privately funded historic restoration.

Photo exhibit *Lemont and Its People* opens, and videotape on local quarrying industry prepared.

Revolving Loan Funds used to renovate old terminal property on Des Plaines River; barge unloading to begin there. New motel opens.

UPS announces plans for reuse of former General Motors plant in Willow Springs. Oscar Mayer Company builds distribution center in Joliet.

I&M Canal bibliography published by NIU press.

1989

Attendance in Corridor up 2.6%, with 4.5 million visitors at 25 sites.

Isle a la Cache Museum in Romeoville rehabilitated.

Illinois State Water Survey completes hydrology study on additional water needs of Canal for aesthetic and recreational purposes.

Corridor Commission adopts Preservation Treatment Policy for use of Commission funds.

Department of Conservation completes following rehabilitation projects: Aux Sable Aqueduct, Little Vermilion Aqueduct, resurfacing of 30 miles of I&M Canal towpath.

Land and Water Conservation Fund authorizes $561,000 for land purchases in Corridor. Three land parcels acquired.

Work begins on Fitzpatrick House, donated by Material Service, slated to be Commission's offices.

Historic Cemetery Preservation Conference held.

Filming begins on Canal Corridor, to be released in spring of 1990.

Chicago Maritime Society opens new museum in Chicago, including information about importance of Canal to Chicago's growth.

Rehabilitation of Gebhard Woods Interpretation Center begun by IDOC.

Acquisition of Lake Renwick Heronry near Plainfield.

Passage of $50 million bond issue by Will County Forest Preserve District provides monies for rehabilitation of historic industrial properties and open lands preservation. ■

Portions of this Guide excerpted from materials provided by the Illinois and Michigan Canal National Heritage Corridor Commission and the National Park Service.

REBUILDING AN ECONOMY

by Charlyn Fargo

Along the winding Illinois and Michigan Canal Corridor in northern Illinois, economic development is taking place at a steady pace. Buildings have been restored and rehabilitated, new businesses brought into the area, and legislation passed to help fund new projects.

"I don't know that economic development (of the Canal Corridor) is booming," says Sue Bobinsky, head of the Heritage Corridor Convention and Visitors Bureau. "Economic development takes a longer time."

But there has been progress in the six years since the Illinois and Michigan Canal National Heritage Corridor, as it is officially known, was established in recognition of the area's past and potential contributions to the nation's development.

A Transportation Corridor

The first order of business was keeping those businesses that were already in place. "Retention of businesses is a big portion of economic development," says Bobinsky. And it's not always been easy or successful. Ten years ago, the electronics arm of General Electric employed 17 thousand in the Canal Corridor. As competition increased worldwide, the plant cut back and seriously considered moving facilities to Canada, says Bobinsky. "It's down to four thousand workers now, but we were able to help convince them to stay in the area."

The Gaylord Building, Lockport (Credit: Hedrick Blessing)

Several regions within the 120-mile-long Canal Corridor have been designated Illinois Enterprise Zones, qualifying them for incentives from the state.

In Joliet, one of the oldest steel mills in the nation was abandoned, along with a host of other manufacturing facilities, bumping unemployment numbers to over 26 percent in the early 1980s.

But in the last three-and-a-half years, 10 thousand new jobs have been added, reports Ruth Calvert Fitzgerald, President and CEO of the Joliet/Will County Center for Economic Development. "Being in the Corridor is one of our selling points," says Fitzgerald. "It's one of the amenities we can offer in terms of quality of life."

In the 1800s the Canal allowed cargo to travel from New Orleans to Buffalo, New York. And, following the lessons of the past, in early July of 1990 Joliet unveiled a downtown masterplan for the waterfront area, where barges still pass through.

Barge transportation lost out to railroads and eventually highways in the old days, but the Canal Corridor's importance as a transportation link is still evident.

United Parcel Service recently took over a General Motors plant in Willow Springs that had been shut down. It will be a $150 million project for a national distribution center. "This is still a transportation corridor," emphasizes Bobinsky.

Officials believe that development of recreational and educational facilities is key to future economic development. "Tourism is the number one growth industry" states Bobinsky. "We can't keep looking for revenues from manufacturing. We're now looking at tourism."

A Major Attraction

Jack Wayland, chairman of the Lock 14 Illinois and Michigan Canal Committee, is working on a project that will dovetail tourism and business. Recently the Illinois legislature approved a bill that authorizes $2.5 million for dredging one-and-one-half miles of the Canal near Lock 14 at LaSalle/Peru and $250,000 for an engineering study. The legislation, to be carried out by the Illinois Department of Transportation's Water Resources Division, awaits the signature of Governor James Thompson. No money was appropriated by the legislature to fund the project, but the Water Resources Division has the option to fund it from other sources.

If approved, Wayland believes the dredging will pave the way for new marinas near the Canal, bringing five million to seven million dollars in revenue each year. The site, near Huse Lake, spans

Joliet Steel Works (Courtesy: Upper Illinois Valley Association)

100 acres. At a minimum, he expects a 600-slip marina to be constructed. The Chicago area currently has fewer than 8,000 slips for boats, while a city such as Detroit has more than 20,000.

"There's a real strong need," says Wayland. "All the marinas are filled to capacity. This is the largest stretch of waterway between Chicago and East Peoria. If you go north, every six or seven miles, you hit a lock, but there's not a lock south of this for 70 miles. People are using the waterways to recreate, but they won't do it unless they have a slip to tie their boat up."

The committee hired Economic Research Association of Chicago to do an economic study of the idea. "They think we'll catch local enthusiasts as well as people from Chicago," said Wayland. "With the high demand for slips, accessibility from two major interstates and the land available, I don't see how it can miss. Our interest in this project is to help local tourism and the region's economic viability - to improve the LaSalle/Peru waterstreet area."

He foresees future hotels, festival grounds, maybe even a civic center as a result of the rejuvenated Canal area.

A Solid Foundation

One of the first projects in the Corridor was a two million dollar restoration of the Gaylord Building in downtown Lockport. It is the oldest industrial structure along the I & M Canal, dating from 1838. The final price tag on renovation surprised owner Gaylord Donnelley. "It cost a lot more than I thought it would going in," says Donnelley. "From an economic point of view, you can't say it was profitable. But I've been told it's been a positive catalyst in revitalizing the Corridor. That's worthwhile."

Originally used as a warehouse, the structure was eventually purchased in the 1870s by George Gaylord, Donnelley's grandfather. Donnelley formed the Gaylord Lockport Company with members of his family to finance the restoration and re-use of the building. It now houses a restaurant, museum and an interpretive center.

"I hope downtown Lockport will be more developed," says Donnelley. "Shopping is the number one recreational pursuit. We need a few more shops to pep up the town. It was a sleepy village, but now it's stirring itself. In fact, the whole area is stirring itself."

Lee Hanson agrees. "I'm pleased about the progress we've made in economic development," says Hanson. "I've been around long enough that I don't hold any illusions that things happen overnight. I'd rather lay a solid foundation than try to make a quick buck."

It was Hanson who made Darryl Anderson, one of the owners of a Super 8 Motel that has located in Ottawa, aware of a revolving loan program that the Corridor Commission offered to spur economic development. "I originally saw an ad in a hotel/motel magazine saying Mendota, Illinois was looking for a motel to be located there," said Anderson. "But by the time I talked to them, they already had one. They told me about Ottawa and to talk to Lee (Hanson). We looked at the area and were impressed with the growth, the proximity to Interstate 80 and the tourism. But we're here because of the Corridor funds. We probably wouldn't have come without that."

The revolving loan program offers lower interest rates and money to businesses that will come into the Corridor. In addition to the motel, another loan of $100,000 was made to Spivey Marine Terminal to purchase an old terminal property on the Des Plaines River, near Joliet. The terminal was renovated and barge operations begun. A third loan was made to a surveying firm in Lockport, which restored an 1860s railroad depot.

Other Success Stories

Larry Bianchi, Executive Director of the Ottawa Area Chamber of Commerce and Industry, has lived in Ottawa most of his life. He has seen the region's economic upturns and downturns firsthand.

"This area suffered from the same economic problems in the late 1970s and early 1980s as most of the rest of the country. It just didn't bounce back as fast. However, the last two to three years have seen LaSalle County's unemployment rate go down to seven percent. In raw numbers, there are more people working in LaSalle County than ever before. The problem is they may be underemployed."

According to Bianchi, Ottawa and environs experienced a significant loss of manufacturing jobs in the past 10 years - approximately two thousand.

The first order of business was helping existing industry to retool and compete in a new, technologically complex world. The Ottawa Chamber of Commerce and Industry worked hard with the city of Ottawa to get the area designated a State Enterprize Zone.

G.E. Plastics is one of the success stories. It has been in the area since the late 1960s, and it is now spending $15 million in a retooling process. With 450 employees and the possibility of additional employees, it is an example of upgrading the economy and providing greater job security. Another existing business, Borg Warner Auto Division (BWD), has been able to add 75 to 100 employees to its already substantial work force of 235.

"There has also been quite an effort in both Ottawa and throughout the Illinois Valley to create jobs," says Bianchi. "Ottawa is willing to work with any industry. What we have attracted in new companies are foreign firms, mainly Japanese."

Three Japanese firms have come to LaSalle County. Mitsuboshi Belting Company (MBO), which makes industrial and auto belts, arrived on the scene three years ago and employs 250 people. Nakagima is a typewriter manufacturer and assembly plant now located in Ottawa, with 75 employees. Ottawa Steel & Wire, a wire production company owned by O & K American (a subsidiary of the Japanese firm O & K), has 15 employees. Bianchi's group is working with the company on its Phase II expansion.

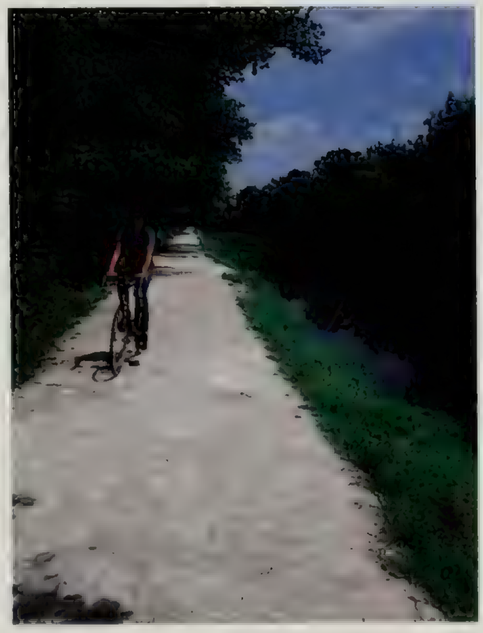
Bianchi stresses retail sales as a good measure of a successful local economy. Since 1984 retail sales have met or beaten inflation every year. Retail sales have risen 6.5 percent in 1986, 8.2 percent in 1988, and 8.0 percent for the first four months of 1990 on an annualized basis.

"Tourism has had a lot to do with our success, as well as people coming to Ottawa as the county seat," says Bianchi. "The city of Ottawa, the Ottawa Chamber and the Heritage Corridor Visitors Bureau have jointly funded an effort to boost tourism. We're also opening a satellite tourism office of the Corridor here. While we don't want to overcommercialize, Ottawa does offer beautiful historical, recreational and scenic attractions that make people want to come here. Starved Rock State Park is just one of the sites people come to see."

Targeting Tourism

Lee Hanson says economic development isn't his strong suit compared to historic preservation and interpretation. However, developing and refurbishing the state parks, forest preserves, local parks and archaeological and historic sites have already begun to pay off. "One of the main focuses in economic development has been tourism," says Hanson. "And we've seen the number of visitors increase 12 percent in the last four years. This year, it looks like it's going to be up again."

At the same time, five new motels located in the Corridor in 1989 and occupancy rates are up at all motels, adds Hanson.



Hike or Bike the I&M Canal State Trail

A new "Fam" tour, to familiarize bus operators with the area, has helped fill motels and restaurants. During the last one, four future tours were booked by bus companies before the tour was over. Operators are taken throughout the Corridor for two-and-a-half days, staying at motels, seeing all the major attractions and eating at local restaurants.

Victor Anderes has owned and operated the Red Door Restaurant in Peru and the Rockwell Inn in Morris for the past 20 years. "I'm sure the establishment of the Corridor has helped my business," says Anderes. "We get people who come here just to visit the Canal. It's hard to say how many, but the Canal adds a lot to the area. What they're talking about now is getting boats like the ones they had in the 1800s to go up and down the Canal near Peru. That would be an attraction."

Anderes lives on top of the Red Door Restaurant, within viewing distance of the river traffic. "We've been part of the waterstreet for 25 years. We even have customers who park their boats, then call us for a ride to the restaurant."

The Corridor's biggest asset is its proximity to Chicago, says Hanson. "For companies, we're promoting the fact that we have a fairly reasonable labor market, an incredible transportation network and great recreation."

Hanson is convinced that having top notch attractions, such as the renovated Starved Rock Lodge and Illinois Waterways Visitor Center, can do as much to help local businesses as bringing in a new business. "The problem is people don't know about the Corridor," says Hanson.

Downtown...and Argonne

One of the Commmission's main goals in the next few months is to work with the Upper Illinois Valley Association to establish a Corridor-wide Main Street program. Up to four communities will be selected to revitalize and market their historic downtown areas. "We haven't picked the cities yet," says Hanson. "But we've got four to six communities that have expressed interest. We're going to make those downtowns work again."

Jerry Adelmann, President of the Upper Illinois Valley Association, says by sometime this fall, applications will be accepted. "There has been a lot of focus on historical architecture, waterfront areas, on a project-by-project basis. The feeling now is that we need a comprehensive approach. And we're seeing a new momentum to do that."

Adelmann believes the heart and soul of any community is its downtown. "People want to go to a place of interest, but beyond that they need to shop and eat and stay overnight," he says. "And for businesses, the image of community is its downtown. A thriving downtown symbolizes local pride and quality of life."

The Canal itself has lost its draw as an economic tool, adds Hanson."Much of the Canal is dry. In some places, such as Chicago, it's even been paved over with roads. Its value is aesthetic,"says Hanson. "It can't be used for shipping anymore. We've got to turn to its historic and aesthetic value."

DANGER
SCNO 7913

Barge locking through at Starved Rock Lock and Dam

The Commission has plans for a movie about the Corridor that will be shown at visitor centers, the placement of wayside exhibit panels at attractions so guides aren't needed, and a brochure to highlight the area's economic development opportunities. The Commission also hopes to have a tour guide book of the region published, including driving and walking tours.

It also wants more groups to take advantage of the area's diverse offerings. Recently a biking group from Chicago used the Corridor's 50 miles of bike paths to host its bike-a-thon. "We had 1,500 bikers," says Greg Kile, Site Superintendent of the I & M Canal State Trail.

Perhaps the brightest star for future economic development lies with Argonne National Laboratory, predicts Hanson. "The laboratory has the potential to attract other spin-off industries to the area." says Hanson. "There is a movement afoot to make sure those industries locate in the Corridor."

Bob Stewart, a Corridor Commissioner and Executive Director of the Three Rivers Manufacturers' Association, believes the next five years will result in more progress than the first five years. "We've started to create a sense of belonging together," he says. "All along the Canal, you're seeing a sense of cooperation that wasn't there five years ago. It's remarkable."

Janet Muchnik, immediate past Chairman of the Commission, puts the Corridor into perspective: "The vision that led to the I&M Canal helped shape the physical features, the economy and the political history of Illinois and of this region. The formation of modern Corridors can create a similarly dramatic impact on the future economy of this and other regions." ■

SURVEYING THE I & M

The soil of Illinois, the wealth of minerals that lie beneath it, its plants and animals, and the water and climate that sustain its life are irreplaceable resources. Since the mid-1800s the three Illinois Scientific Surveys - Natural History, Water and Geological - have conducted research to promote the preservation and wise use of these natural resources.

The expertise embodied in the Surveys has proved invaluable in the work of preserving, researching and renewing the Canal Corridor.

Reach Out and Teach Someone

At early briefing sessions in 1980, when Open Lands unveiled its dream of a new kind of historical park, the Illinois Geological Survey (IGS) was there with information no one else had, according to *Tribune* outdoor writer John Husar.

From its archives, maps and publications, and from the mouths of its geologists poured stories of the forces that shaped the land that shaped the economy that shaped the settlements from prehistory to present day.

"The I & M Canal played a unique role in the economic development of the region and the nation. An appreciation of its geological setting adds to its continuing historic, natural, recreational and educational value," sums up Dr. Morris Leighton, Chief of the Illinois Geological Survey.

The gathering and sharing of information did not stop with federal designation in 1984.

Lisa Smith, an IGS geologist, undertook a mile-by-mile odyssey to inspect and inventory the geological and natural features of the I & M Canal Corridor under a grant from the Commission and the Department of the Interior. *Ice Age Geology*, a fold-out Park Service brochure, written by Lisa and Ardith Hansel of the IGS, is an inspired short course in geology.

View of Illinois River from Starved Rock

It interprets the beauty and variety of the landscape along the Canal; explains the birth of distinctively shaped hills and ridges, bedrock gorges, marshes and lakes; and describes the evolution of glaciers and glacial meltwaters.

Smith's research provided, in addition to *Ice Age Geology*, the basis for a number of IGS publications. Among them is a field trip guide for the Canal Corridor Joliet area, authored with staff geologist David Reinertsen. Reinertsen has led four field trips a year for the past ten years through the Survey's Educational Extension Unit. These day-long trips acquaint the public with the state's landscape, rock and mineral resources, and the geological processes that shaped them.

Built on Rock

Lime and building stone were major construction materials in the Canal Corridor from the days of pioneer settlement. Beginning in 1848, mules and horses drew limestone laden barges to building sites up and down the Corridor. Segments of original limestone sidewalks can still be seen today in Lemont and Lockport. This distinctive building material was used throughout the Corridor region.

The turn of the century brought changes in economic conditions and construction materials that caused the collapse of the building stone business. However, early in this century crushed stone for aggregate became the primary product of the local stone industry and now accounts for $100 million annually in the Chicago area alone.

Sand, gravel and stone are used today mainly for making concrete, macadamizing roads and for railroad ballast. Ironically, the enormous growth of metropolitan areas that creates the demand for crushed stone eliminates local sources by choking off expansion where near-surface reserves are known.

Illinois Geological Survey researchers are working on locating alternate sources and developing new methods of mining - research that is of the utmost importance to the health of the construction industry. Using historical literature (such as unpublished census data and old newspaper accounts), field reconnaissance, and sophisticated computer imaging, geologists are able to make recommendations for economically viable quarry operations.

Lock No.1, Lockport

Trouble-shooting the Canal

"The Water Survey's work on the I & M Canal is illustrative of our mission in relation to Illinois' water resources. Our role is one of investigation - to assess the problems, and then to use our scientific and engineering skills to suggest solutions to those problems," explains Richard Semonin, Chief of the Illinois Water Survey(IWS). "It is often up to other state agencies or those in the private sector to actively implement those solutions."

In 1980 and again in 1981 heavy rainstorms flooded farmlands adjacent to the I & M Canal between Morris and Seneca, damaging corn and soybean crops in the area. At the request of the Illinois Department of Conservation (IDOC), which manages the Canal, Water Survey scientists and engineers assessed what the flooding situation would have been if the Canal had not been built. Extensive hydraulic and hydrologic investigation and soil studies indicated that the Canal was not responsible for the flooding.

On the contrary, "...if the Canal did not exist, it is likely that flooding of the area under investigation would be greater than it is now," reported Mike Demissie, the Water Survey's principal investigator in the case.

Exonerating the Canal, however, is not the primary goal of IWS research projects. A preliminary evaluation was recently completed under a $10 thousand grant from IDOC to determine the feasibility of rehabilitating the I & M Canal in the Lockport area. The resulting report indicates that rehabilitation and maintenance would require significant effort and a significant infusion of funds. For this reason, the study recommends that rehabilitation efforts be pursued in stages.

The report specifically cited three main tasks that could be accomplished without further studies: (1) rehabilitating Lock No.1 and installing a tiltable weir (small dam); (2) clearing and cleaning the Canal within the targeted segment; and (3) making arrangements with a nearby Texaco plant to modify its water control structures so that adequate water is available in the I & M Canal.

The report also indentified problems in need of additional and detailed investigations and outlined the estimated scope and cost of such studies.

According to Nani Bhowmik, the Survey's hydrology and river mechanics specialist, maintenance of a minimum water level, at least from spring through fall, would allow the recreational use of the Canal in the Lockport area by providing sufficient water for canoeing. He added, optimistically, "With proper reconstruction, parts of the Canal could become an important recreational waterway in the nation comparable to many canals in Europe."

That, most likely, will be the subject of future studies.

Watching the Birds

Unless you're a serious "birder" you've probably never spotted (in travels around Illinois) the black crowned night heron, the double-crested cormorant or the great egret. These three birds, on the state's endangered list, breed on two small islands in Lake Renwick, a former quarry, just one mile southwest of Plainfield. They are joined, at one time or another, by nearly 70 other bird species, including six additional state endangered species.

Redwing blackbird in marsh created by quarrying

Rookery at Lake Renwick

Lake Renwick, a secluded 316-acre spring-fed gravel pit, is included in the Illinois Natural Areas Inventory because it supports the state's largest and most diverse heron rookery. The first heron sighting in the area was reported by the Illinois Natural History Survey (NHS) in 1942.

The good news - bird populations have increased dramatically over the years; the bad news - there is fierce competition among the birds for nesting space. Unfortunately, the constant encroachment of civilization means there are very few places in the area for these birds to move. The necessities of bird life (food, perching and nesting) are in jeopardy.

The dominant trees on the island, box elders and Siberian elms, are becoming more and more distressed. As the trees age, there is increasing damage from wind, from continual scavenging for nesting twigs, from an excess of acidic bird excrement, and from the stress of increasing numbers of large birds taking off and landing. There is real cause for concern that the biosystem that functioned so well over the years might collapse. (It has been protected from human interference by Chicago Gravel Company fences.)

The area has long been a focus of serious birdwatchers and conservationists, but in 1987 it was the Illinois Department of Transportation (IDOT) that focused on Lake Renwick. The department was working on a proposal to widen Route 30, which skirts Lake Renwick's southern shore, and it contracted with the Natural History Survey to assess the effects of a major road project on the avian inhabitants.

A two-person NHS team, armed with binoculars and a 60X spotting scope, monitored bird arrivals, foraging habits, and mating and nesting activities from April through December, 1987.

Field observations were weighed in light of earlier NHS research, and expert testimony was solicited from naturalists and scientists familiar with the area.

The resulting study addressed the proposed highway project as well as the major conservation goals of the I & M Canal Commission, Upper Illinois Valley Association, the Will County and Illinois Audubon Societies, the Forest Preserve District of Will County and the Illinois Department of Conservation.

Recommendations were made for strategies during construction that would result in the least amount of disturbance to bird populations, especially the breeders. The study proposed additional management strategies, including the building of artifical nesting structures (successfully used at Baker's Lake in Barrington), upgrading the lake's third island to make it more desirable for nesting, and adding a buffer zone to shield birds from traffic noise and trespassing fishermen.

For the time being, however, the road project was put on hold. This past January the Lake Renwick property was purchased from its private owners by the Forest Preserve District of Will County and IDOC.

Lake Renwick will be closed to the public for about a year and then provisions will be made for carefully monitored interpretive field trips.

Joe Milosevich, Audubon member and official census taker at the heron rookery, who first dreamed of protected status for Lake Renwick more than seven years ago, said it well: "...wishful thinking provides a practical starting point."

In their work in the Canal Corridor, Illinois' Surveys have added the application of sound scientific research to wishful thinking. Their efforts ensure that the nature of the Canal will always be remembered, protected and managed wisely. ■

Glacial boulder, Goose Lake Prairie

THE PEOPLE OF THE CANAL

By Tara McClellan

As the Illinois and Michigan Canal channeled its way through history, it intercepted the lives of thousands of people. These are the people of the Canal. Their commonality is a vision, a passion, something which tugged at, and in some cases, defined their hopes and dreams. To the Indians the area was their existence; to the explorers the Canal was a link between two worlds; to the immigrant workers it was a future and a fortune; to the politicians who struggled to finance it, it was a passageway to a prosperous new era; to the railroads which eventually defeated it, it was a competitor.

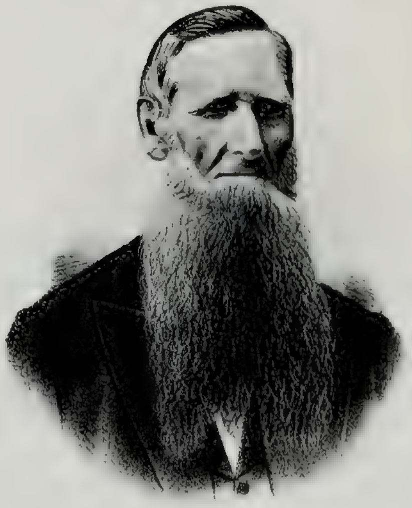
To Canal town inhabitants it was and is a way of life. And to the people who now reclaim it, it is the perfect marriage of the past and the future. It is hope, promise and passion for what has been and what can be.

Genesis

The first people of the Canal area were Native Americans. As early as 6000 B.C., they used this as a major transportation artery through the valleys and prairies where they farmed and hunted plentiful game. Tribes later traded furs with French *voyageurs*, who depended upon the area's waters for their living.

The Frenchman's tie to the area began in the 17th-century when two explorers were paid to determine if the Mississippi River flowed south. If so, France would be able to increase its trade business and gain Catholic converts in the Great Lakes region. In 1673 map-maker Louis Jolliet and Jesuit missionary Father Jacques Marquette, with an Indian guide, determined that the Mississippi did flow to the Gulf of Mexico, with the Illinois and Des Plaines Rivers as northern tributaries.

According to John Lamb, Director of the Lewis University Canal and Regional History Special Collection, when Jolliet returned to Montreal he urged the French government to dig a river between the Chicago and Des Plaines Rivers. This would open a transportation corridor from the Niagara River to the Gulf of Mexico and help establish colonies.



William Gooding designed the Canal and made certain it featured hydraulic power. He was involved with the Canal until his death. (Courtesy: Illinois State Historical Library)

However, a few years later explorer Robert Cavalier de La Salle traveled the area and discounted Jolliet's idea.

Interest in the region declined until 1780, when Americans saw it as a way to move west via the Great Lakes and Mississippi River.

Only after the territory became a state, and state government took charge of the project, did the Canal became a reality. During this time the legislature suggested building a railroad instead of a canal.

Jerry Adelmann, President of the Upper Illinois Valley Association, says Abraham Lincoln, a legislator at the time, "argued persuasively that the Canal was much more democratic (than a railroad). He contended that anyone could put his boat on it, if it were not controlled by this monopoly, the industrialist." Lincoln helped create legislation which started the Canal's development.

Finally, in 1836, the state began construction. The Canal Commission appointed William Gooding to be the Canal Engineer. Gooding, who was Chief Engineer of the Canal from 1836 to its completion in 1848 when he became Secretary of the Canal Board of Trustees, planned a new route. He designed the Canal so it could be used not only for transportation but also for hydraulic power to draw industry. Gooding, who Lamb describes as "very much a Yankee," waded into political conflicts with cities along the Canal who were afraid one city would receive more hydraulic power than the other. He won, and hydraulic power remained part of the project.

The Immigrants

Thousands gave their lives to build this new passageway to prosperity. When construction began, there weren't enough residents for a workforce. Irish workers who had helped build the Erie Canal about a decade earlier were transported in, but more were needed. Canal supervisors shipped in additional workers from Ireland (and other countries) on a promise of money and a dream of liberty. Most were illiterate men and boys who left their families to come to this land of opportunity.

"They didn't promise them much other than a job, a gill (one-fourth of a pint) of rum and ninety cents a day for a full day's labor - maybe 16 hours," Lee Hanson says. But Ireland was experiencing a famine, so any job at any rate sounded good. "The labor was pick and shovel work, wheelbarrow work, literally carving out the Canal. And when they hit rock it became tougher...it took a long time."

The money, or scrip, they were promised was virtually useless. "It turned out to be paper which was only good for buying Canal land," Hanson says. "So what they ended up with, some of them, was a lot of land." They scratched out a living, though many died from malnutrition, cholera and other diseases resulting from unsanitary living conditions. Accidents and assaults maimed and killed others. Escape back to Ireland was an idle dream. They had no money.

"Let's face it, the foremen and the contractors that brought these people out here did cheat them. They did take some of their salary for lousy food. The workers were living in tent camps, terrible living conditions...But these guys had very little recourse. The local sheriffs would support the contractors more than the Irish, so there wasn't anybody to turn to," Hanson says.

There were worker riots, although Hanson adds that there was also infighting among Irish clans who carried their feuds over from Ireland. Area settlers, who harbored no fondness for the immigrants, responded by organizing posses to keep the peace. They attacked the rioters, killing many.

Some of the Irish workers became wealthy. They used their scrip to accumulate land and become successful farmers, as did some German Canal workers. Later, Polish, Slovenian, Lithuanian, Italian, and other immigrants came to work in the quarries, coal mines, steel mills, and other industries that germinated from the Canal. Descendants of the immigrants still populate the towns that sprang up around the Canal - Lockport, Marseilles, Lemont, Seneca, Utica, Joliet, Willow Springs, Morris, Ottawa, and, of course, Chicago.

Lockport was the site of the original headquarters of the Canal Commissioners and the first lock. Flour mills, grain warehouses, boatyards, docks, and Canal offices dotted the town.

Like Lockport, Marseilles had waterfalls and rapids which allowed for the development of waterpower on the Canal. Flour mills and tanneries arose there. Seneca and Utica were primarily grain ports. Joliet had a variety of Canal links: a lock, a lot of trade goods, and railroad connections. And Willow Springs offered the Canal diggers camping and a clean supply of water from its spring (which Indian tribes had once used as a medicinal spring for wounded braves).

About six years after the Canal was completed, the railroads built beside it and became formidable competitors. Thus began the Canal's slow downward spiral.

Reclaiming Their Heritage

It is almost impossible to discuss current reclamation efforts without hearing the name of Jerry Adelmann. Adelmann was a key figure behind the federal National Heritage Corridor designation.

Adelmann's professional ties to the Canal are an extension of his personal ties. He grew up in Lockport as a sixth generation resident. "My great-great-great grandfather was the first settler of Homer township...east of Lockport. My grandfather would tell me stories...that were told to him by his grandmother."

John Husar, Judith Stockdale and Jerry Adelmann (l. to r.) all played significant roles in the development of the Canal Corridor

Adelmann developed an interest in historic preservation and received a master's degree in it. His dissertation topic led him back to his hometown for research. He became involved with reclamation efforts in Lockport which led to his work with the Canal and the Corridor designation.

"In the late 1970s...I got to thinking...there's a whole network along the Canal of interesting towns and landscape features. The whole river valley, in many ways, tells us a story that is quite remarkable, from early geological history through the period of French exploration, fur trade, settlement, and ethnic and labor history."

He was led to the Open Lands Project, which had been working to save the Canal since the 1960s.

"Out of the blue, I got a call from someone named Jerry Adelmann," says Judith Stockdale, then Executive Director of Open Lands and current Executive Director of the Great Lakes Protection Fund and a Federal Corridor Commissioner. She and Adelmann started brainstorming about ways to use all of the Canal's resources and finding funding to do so. They worked together to lobby locally and federally for the unique National Heritage Corridor designation.

"We battled the attitude that there's nothing here worth saving," she says. "But this is a landscape with beauty and it has an incredible history that's been passed over."

Local village leaders, like then-Willow Springs Village Trustee Suzanne E. Bobinsky, have fought the same battle. "To make the public within the Corridor aware of what they have is a very difficult challenge," says Bobinsky, who has worked for the past four years educating citizens about the Canal's history and significance. Bobinsky was General Manager of the I & M Canal Civic Center

Authority, an agency that works on various Corridor reclamation efforts. She is currently Executive Director of the Heritage Corridor Visitors Bureau in Joliet.

The awareness and support of business was, and is, key to the success of the Corridor. People like Thomas Flavin helped get business support. Flavin, General Manager of Business Planning for Inland Steel, has deep roots in the Canal region. Most of his direct ancestors worked on or around the Canal. He had been a member of Open Lands Project for several years and was a founding member of the Upper Illinois Valley Association. Flavin is currently Chairman of the Association and works with the Federal Commission, other groups, and businesses on Corridor projects.

One of the government agencies that saw the light was the Metropolitan Water Reclamation District of Greater Chicago. Nicholas J. Melas, President of the District's Board of Commissioners, said Open Lands Project and others approached the District in the 1970s about establishing a national linear park along the Canal. The District leased about 400 acres along the Canal to establish the Centennial Trail (with more acreage to come), so that people could hike from the southwest suburbs of Chicago to Lockport. The District is also working with the Civic Center Authority to build a museum about the I & M Canal and the settling of Illinois.

Private support was also crucial to the Canal's reclamation. Key individuals, like Edmund B. Thornton, took the Canal projects to heart. Thornton grew up fishing in the Canal and walking and horseback riding along its towpaths. In the 1960s he helped save an abandoned stone warehouse in Utica that was going to become a parking lot. Now it is the La Salle County Historical Society Museum.

Man opening wicket gate on I&M Canal (Courtesy: Illinois State Historical Library)

"My early days of youth were being transformed into preserving and promoting certain features on the Canal," he explains. Thornton felt a federal commission should be created to handle the Canal and he became its first Chairman.

Another individual who developed a key Canal project is Gaylord Donnelley, Honorary Chairman of R.R. Donnelley and Sons Company, and a board member of the Upper Illinois Valley Association. Donnelley's ancestors were Lockportians. His grandfather, George Gaylord, had bought an old Canal warehouse for a shipping and grain business and a store. In the early 1980s, Donnelley, family members, and others formed a corporation to buy and restore the warehouse. The building received one of the first Presidential Historic Preservation Awards.

The Past, The Present, and a Passion

But why have these people donated so much of themselves to the Canal?

"The whole thing, all of the work, is generated by those who have a passion," Bobinsky explains. "It's exciting. I've been involved in many things all of my life, but this is one project that seems terribly worthwhile because of the...vision, sense of history, and commitment."

"There are a lot of people out there who care...and it's that personal conviction, that personal passion I think that drives them," Adelmann says. "I think for many people, until recently, the Canal was seen as a dirty ditch...That has changed, and it is now becoming a symbol of the greatness of the area, a symbol of achievement, of hope for the future."

"It has to do with history and conservation," Donnelley says about his involvement. "I think it has a lot of potential to become a very attractive place to visit...It represents another era, and it helped to develop that whole Illinois River corridor...it wouldn't have developed without the Canal."

"It goes back to the spirit of man," echoes Flavin. "Heritage is a great motivation...you realize how much has been given to you and you don't want it destroyed. You want to pass it on to your children. These efforts are a hope for the future." He believes the Canal gives people a personal tie to history so "they can be part of it, and it helps give them a sense of responsibility about developing their communities." ■

When the Irish immigrants traveled here to build the Canal, they had no place to worship. After six back-breaking days of work, the Irish spent Sunday, their only day of rest, cutting rock and constructing St. James of the Sag, a Catholic church overlooking the Canal. Today the churchyard is filled with the graves of these workers, many of whom died while building the I & M.

Tombstone at St. James on the Sag cemetery

One Irish folksinger was so moved by the saga of the immigrants, their struggles, and the stories told by their weathered gravestones that he researched their history for six months and wrote this song. By Kevin O'Donnell of the Irish folksinging group *Arranmore*, it tells the story of the Irish immigrant workers in a manner they would have appreciated.

The Illinois & Michigan Canal

On a hill behind the chapel, in the Parish of St. James
Are weather-worn and tangled graves with mostly Irish names.
These faded flagstone monuments bear witness to a dream
That a hundred fifty years ago no one could have foreseen.

In a young town of Chicago on the Plains of Illinois
The I&M Commission brought in desperate men and boys
To have them build a great canal and change the river's flow
And wed the Great Lakes' waters with the Gulf of Mexico.

They came from ports in Galway, from Cork and Baltimore
On a promise of more money than they'd ever known before.
To carve a new beginning in a land of liberty
They said goodbye and sailed across the sea.

So bid farewell to famine, it's off to Americay
To work as a navigator for ninety cents a day.
And hope to dig a fortune by the time they reach LaSalle
On the Illinois and Michigan Canal.

Ten thousand Irish navvys reached out across the land
And picked their way through the mud and clay and moved it all by hand.
While the tyrant canal foremen worked poor "Paddy" without pay
As he dreamed about his family in a country far away.

For empty-handed promises were all they came to know
With food and tools in short supply and money running low.
Though many tried, thousands died, longing to be free
Where the wild Blue Stem grasses grow as far as you could see.

Then the coming of the railway made their efforts obsolete
For it ran along her banks before the digging was complete.
The locks were finally opened and they tallied up the cost
With no mention of how many lives were lost.

Now gone are the locks and boatyards, the barges and the scows
And the clapboard shacks of "Corktown" where the navvys used to house.
From Bridgeport to LaSalle and every town along the way
Only remnants of this great canal can still be seen today.

Neglected through the ages, her water will not flow.
And where mule teams pulled the river boats, now wild poplar grow.
Where canaling was a way of life that I might have tried myself
It's now buried in the pages of some book upon a shelf.

And in the corner of that graveyard in the Parish of St. James
Lies a noble Irish navvy who helped pioneer these plains.
Who fled the great oppression just to build himself a home
Now it's the only piece of sod he'll ever own.

So bid farewell to famine, it's off to Americay
To work as a navigator for ninety cents a day.
And hope to dig a fortune by the time they reach LaSalle
On the Illinois and Michigan Canal.

K. O'Donnell
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(continued from p. 8)

fever. Railroad enthusiasts were bringing the good news of rail transportation to Illinois, and, on paper at least, their arguments were not helping the Canal's cause. A heated debate between Canal proponents and pro-rail forces kept the dialogue alive in the General Assembly. However, rail transportation had hidden costs.

"Shipping by canal was, in round figures, about one-tenth the cost of shipping by rail," says University of Chicago geographer Michael Conzen. "Canals provided very cheap transportation for non-time-sensitive freight. One could move tons of cargo at a very low cost, provided that time was not a consideration."

The rail/canal debate continued in Illinois until federal funds were finally approved for the construction of a harbor in Chicago in 1834. With the opening of a Great Lakes harbor at Chicago, the issue died for a while. Finally, the canal seedling germinated and sprang through the soil into the bright Illinois sunlight.

William Gooding, a canal engineer who had worked on the Erie Canal, was hired by the Commission in February of 1836 to bring the I & M Canal to fruition. He wanted to build a canal large enough to accommodate the future of the shipping industry, and advised that a "deep cut" canal be built. The Canal was to be 60 feet wide at the water level, 36 feet wide at the bottom, and not less than six feet deep. The first shovel turned at Canalport (now Bridgeport) on July 4, 1836.

Meanwhile, independent town promoters had established communities in the Corridor. The town of Peru was platted in 1834, and about the same time Joliet and Marseilles were established on land purchased from the federal government. Acting to thwart private development of the 96-mile Canal Corridor, canal commissioners set up canal towns opposite Peru (LaSalle) and north of Joliet (Lockport).

"Lockport was originally settled northeast of here," says Rose Bucciferro, President of the Will County Historical Society in Lockport. "It was called Runyon Town. With the construction of the canal commissioners' building, the town just moved to where it is today." Lockport is also the site of Lock No.1 on the I & M Canal. "There were two auxilliary locks to the north," continues Bucciferro, "but your lock system starts here because you have your first fall. And there are four more locks between here and Joliet. This was the business and administrative hub for the canal."

APRIL 9-1865

The I&M Canal terminus at LaSalle (Courtesy: Illinois State Historical Library)

Other towns in the Corridor came later: Morris, Channahon, and Lemont in the mid-forties, Seneca in 1849, and lastly Utica in 1867.

From 1837 to 1839, using mostly Irish immigrant labor, the Canal project moved forward. By the end of 1839, it again faced abandonment for lack of funds. In 1841 construction came to a standstill for nearly four years. When the Illinois State Bank failed in 1842, the prospects for the Canal's completion were non-existent. To save money, Gooding's deep water canal system was abandoned in favor of a shallow cut canal.

To complete the Canal, the state had to borrow money from foreign investors.

Racing with the Railroad

On April 20, 1848, the Canal opened for navigation, eleven years, nine months, and sixteen days after work on it had begun. The Erie Canal, 267 miles longer than the I & M, was completed in only eight years.

For the next six years, the Canal grew in reputation and prospered. But in 1854, the railroads - true to their promise - brought competition and faster service to the Corridor.

The Canal was never a wildly successful business venture, according to Rose Bucciferro of the Will County Historical Society. "It was put out of business by the railroads in the late 19th century. They kept their rates and fares low until the demise of the Canal, and then they hiked them right back up again."

A quarter-mile west of the Canal at Lockport, the Chicago Sanitary and Ship Canal, a deep cut channel completed in 1900, is home to the barges that still haul tons of goods from New Orleans to the Great Lakes and beyond. Outside the Illinois and Michigan Canal Museum, a bed of steel rails separates the old canal commissioners' house from the shallow ditch where the I & M Canal flows.

Every so often, a train whistle blows boisterously through the Corridor, as the now quiet waters lick old limestone wounds, and remember a proud, noble heritage. ■

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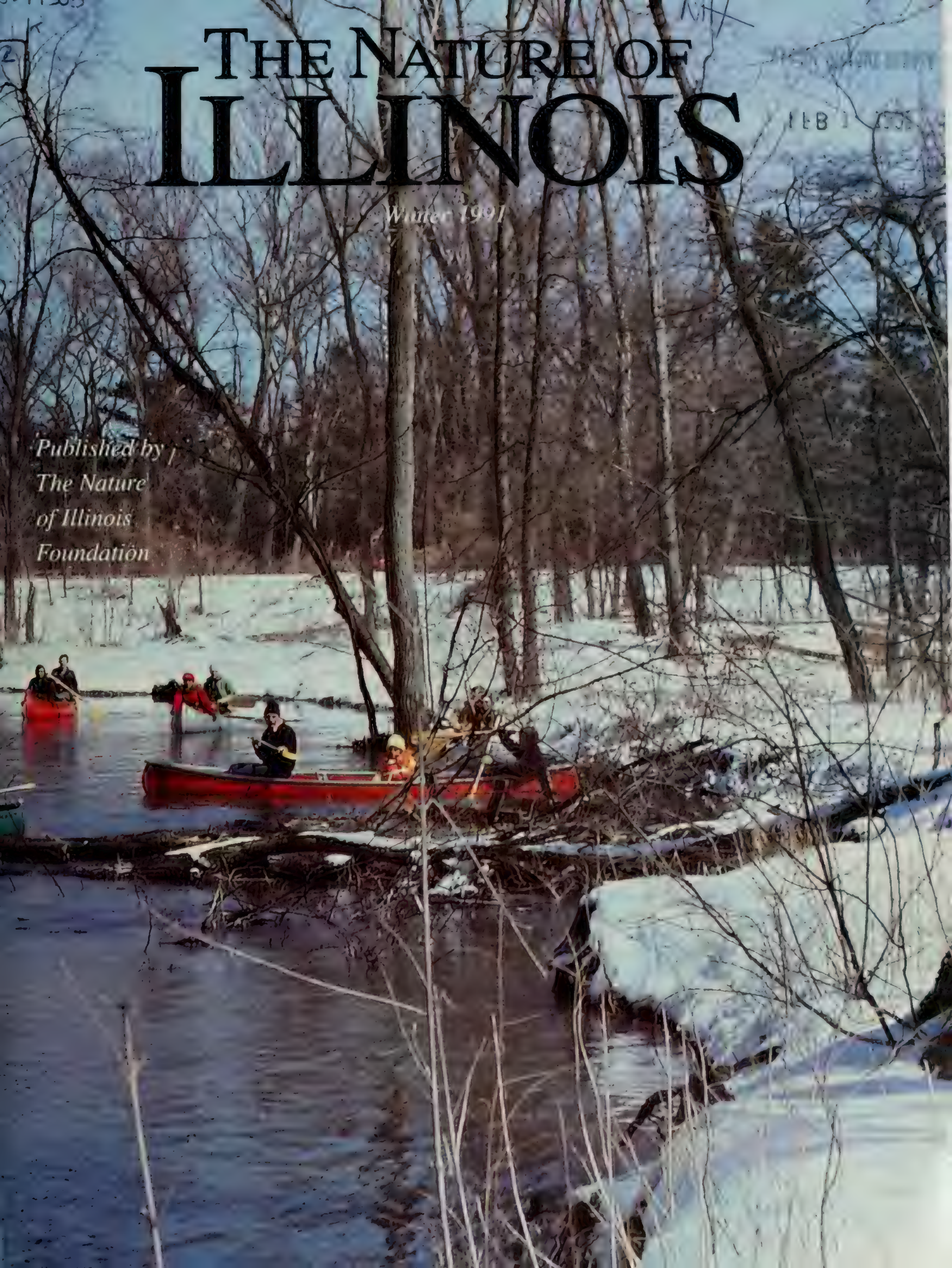

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THE NATURE OF ILLINOIS

Winter 1991 - A Delicate Balance

From the Foundation

All of the articles in this issue point to the delicate balance that exists between economic growth, the esthetic quality of life, and human health. **"Chicago River Renaissance,"** is the account of a river's close link with the health, prosperity, and quality of life of the people in a great city.

"The Pearl Rush" follows the rise and fall—and rise again—of the mussel-fishing industry in Illinois. Another waterborne article deals with the genesis of our own State Water Survey, founded on the need to protect the quality of our state water supply through scientific investigation and research.

"Mapping Illinois" is a striking example of technology and sound scientific research working toward solutions for landfill dilemmas and groundwater protection problems. On a more intimate scale, you might get a chuckle and some good suggestions from **"Uninvited Houseguests"**—yet another example of environmental management.

A lively variety of topics to read about—with this underlying message—it is vital that we, as stewards of our environment, make today's critical decisions on the basis of sound scientific research.

The three Illinois Scientific Surveys—Natural History, Water, and Geological—and the Hazardous Waste Research and Information Center are powerful allies as we balance what we want and need with what the earth requires of us.

I hope you will join me in becoming a member of The Nature of Illinois Foundation and that you will enjoy learning more about the subjects covered in this issue of ***The Nature of Illinois***.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Winter recreation on the North Branch of the Chicago River
(Courtesy Ralph C. Frese, Chicagoland Canoe Base, Inc.)

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Editorial Staff
Jean Gray *Editor*
Estie Karpman *Assistant Editor*
Michael Jeffords *Photographer*

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Stay In Touch

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CHICAGO RIVER RENAISSANCE

by Mike Isaacs and David Foster

The Chicago River, downtown: the city's other skyline

If the Chicago River had been born with both a heart and a soul, it would likely have developed an inferiority complex. Like a neglected child who has stood in the shadow of a favored sibling, the river was eclipsed by Lake Michigan and left with a questionable legacy.

Lake Michigan inherited sailboats gliding along a blue horizon; power boats pulling waterskiers in their foaming wakes; netloads of wriggling silver smelt; sandy beaches, alternately lapped and pounded by waves; the excitement of air and water shows; and the colorful explosions of 4th of July fireworks.

Lake Michigan got the glory. The Chicago River got the garbage.

Not Such a Bad Beginning

As early as 10,000 B.C., after the last glacier retreated northward, Native Americans paddled canoes along serene waterways, presaging today's growing band of waterway enthusiasts. Evolving Indian cultures, immortalized today in scattered archaeological sites along the Chicago River, spanned the years before the French arrived on the scene.

The recorded history of the river begins in 1673, when Marquette and Joliet made a momentous portage from the Des Plaines into the West Fork of the South Branch and recognized the river's importance. This small, sluggish stream suddenly became a strategic objective in the European quest for empire. French explorers had heard from Indians of a great river that opened into a great sea, and they spent decades looking for what they hoped was a direct route to China. What they found instead was an easy portage between the Great Lakes and Mississippi watersheds.

Fur trappers and traders followed the explorers, but the French established no permanent settlement along the river, which for the time being remained in possession of the Indians. The area passed to the British in 1763 after the French and Indian War and in 1783 to the United States. Recognizing the importance of the Chicago River, the United States in 1795 negotiated with the Indians for the mouth of the Chicago River—and in 1816, for the entire river corridor down to the headwaters of the Illinois River. Not only was this an important transportation corridor for men and supplies, it was vital for the protection of the western border of the fledgling country.

Westward expansion continued, but the first real growth spurt for this promising portage occurred in 1830, when the Illinois and Michigan Canal Comm sion, created by the Illinois State legislature, laid out towns at each end of the proposed canal–Ottawa on the west, Chicago on the east. Chicago's first real estate boom followed and early fortunes were made. Incorporated as a city in 1837, Chicago grew into a major depot for the trading of raw materials and manufactured products.

Consequences of Prosperity

From its earliest days, Chicago dumped garbage in the river. That was state-of-the-art sewage treatment technology in those days. We may look back in dismay, but the truth is: they did what they knew how to do. And, in a sense they were not wrong. Moving water is a powerful cleansing agent; if a river moves far enough and fast enough, garbage thrown into it will break down.

These disposal techniques did not pose a problem at first. After a short river run, everything flushed efficiently into Lake Michigan. But Chicago's population grew and so did its industry. By the latter part of the 19th century the river could not carry the load that was required of it, nor could the lake dissipate it quickly enough.

Reversing the River

The first (and not widely known) reversal of the river occurred in 1865 when the state authorized the lowering of the I&M Canal in an attempt to make the river flow away from Lake Michigan and toward the Mississippi River. In 1885, the sewers and the river were not up to the task of holding all the water and, after a particularly severe rainfall, raw sewage backed up into the lake again. More than 90,000 people died from cholera and typhoid.The tragedy led to the creation of the Sanitary District of Chicago—now called the Metropolitan Water Reclamation District of Greater Chicago (MWRD).

Entry onto Chicago's scene of such major polluters as the stockyards and packing houses had compounded the city's problems, and, in the last decade of the 1800s, the new Sanitary District built the newer, wider, deeper Sanitary and Ship Canal to carry the city's waste away. It was hoped that this engineering feat would permanently reverse the flow of the Chicago River and that polluted river water would never again enter the lake. This artificial waterway opened in 1900 and cost $24 million.

"The water quality of the Chicago River system has improved significantly over the past 20 years..."

Thomas Butts,
Illinois State Water Survey

Hardly two decades had passed, however, before it became clear that additional sewage treatment was needed. Every time it rained heavily, the swollen river returned to its natural course. The Calumet Water Reclamation Plant, still in operation today, opened in 1922 and was followed by additional plants.

The most recent weapon in the arsenal of the water treatment war is MWRD's Tunnel and Reservoir Plan (TARP), called Deep Tunnel by most Chicagoans. First proposed in the late 1960s, it was designed as a backup system to prevent the overflow of raw sewage into the river during and after heavy rainstorms. The massive underground tunnel system receives the excess flow from 5,000 miles of existing stormwater sewers; and there the water remains until the storm subsides and MWRD plants can pump it up and clean it. The system is still incomplete, slowed by political controversy and a lack of funds. Still, the river is cleaner: the tunnels have reduced the number of sewage overflows.

One factor, not to be overlooked in a finer future for the river, is that some of the early polluters, such as meat packers and the stockyards, began to leave Chicago soon after World War II. The combination of the loss of polluting industry and improvements in sewage treatment was a great boon for the river. By the late 1970s the river only *occasionally* had raw sewage floating in it.

Sluice gates at Wilmette

WENDELLA
BOAT RIDES
1-1½-2 HOUR
BOAT RIDES
PEPSI
DOCKING

Wendella, in operation since 1935, offers sightseeing tours and commuter service from the Northwestern Station to the Michigan Avenue Bridge in spring and summer.

Chicagoans began to think of the river as an asset. For the first time, they could actually see it. (Before the end of World War II, the river was flanked with business and industry, so you couldn't get close to it. And probably you wouldn't have wanted to, because *it was a sewer!*)

An early visionary, architect Bertram Goldberg, saw the possibilities of using the river as an integral part of his buildings and in 1959 he completed the Marina City Complex. The twin towers included a built-in marina and a restaurant overlooking the river. Prior to this, Chicago buildings literally turned their backs to the river.

Mayor Richard J. Daley had dreams of better days for the river —a future in which you could actually "fish in the river." But such dreams take time and effort.

Some Friends for the River

"No major transformation . . . can be expected until the river is cleaned up," wrote Robert Cassidy in an article about the Chicago River in *Chicago* magazine in 1979. The article led to the founding of Friends of the Chicago River (FOCR), a not-for-profit advocacy group organized "to promote the Chicago River and its adjacent lands as an historic, visual, recreational, commercial, and hydrological resource." After becoming part of the Open Lands Project in 1980, one of the Friends' first accomplishments was to provide the impetus for amending the Planned Development Ordinance (1983). This amendment, strongly recommending public access to the river as a necessary component of any riverfront development, was the first legislation adopted by the Chicago City Council to guide and encourage development along the Chicago River.

Friends of the Chicago River was reorganized in 1988 as an independent entity and has been a powerful ally of the Chicago River ever since. FOCR was a major participant in a study that led to the announcement by Mayor Richard M. Daley on March 12, 1990, of the Chicago River Urban Design Guidelines: Downtown Section. Co-authored by FOCR and the Chicago Planning Department, these guidelines were adopted by the Chicago Plan Commission and offer developers clear and detailed suggestions on location of buildings, provision of walkways, landscaping, and seawall treatment. "It is time," said the mayor, "to be as proud of our river as we are of the lakefront."

FOCR has sponsored symposia and national conferences on water-related issues and has initiated clean-up days, boat tours, and jazz cruises. With the Mayor's Office of Special Events and the City of Chicago, FOCR cosponsors the annual Chicago River Serenade—one of Chicago's many summer festivals. Centering around the river, the Serenade has included such events as a small ships parade, a symphony orchestra on a floating stage, a street cafe, raft races, and a Venetian Night Masked Ball.

The Friends field a number of diverse committees, according to Beth White, FOCR executive director. "This way, we have a satisfying task for everyone who loves the river, no matter what his or her strength, talent, or interest may be.

Walkway under the Michigan Avenue Bridge, one of 52 movable bridges owned by the city of Chicago

FOCR mapmakers have produced four maps, each one covering a different walking or driving tour along the river. Historical, architectural, and natural features of the river are explained, described, and located on the maps. According to Alison Zehr, FOCR's program director, there are seven separate walking tours based on mapped segments of the Chicago River Trail.

Rubber Ducks and Iron Oars

The river has become a focal point for more and more activities. This past August, thousands of spectators lined the banks of the river to witness a major event in the annals of water sports. At the sound of an air horn, nearly 30,000 rubber ducks raced against each other in a rare "rubber ducky" competition. Participants in the derby donated $5 to adopt a duck, which bobbed and floated downriver across the finish line.

Oxford and Cambridge brought their 160-year-old rowing rivalry to the waters of the Chicago River. It was one of Oxford and Cambridge's rare foreign exhibitions, and the first such exhibition in the United States. "This was an ideal place to duplicate our London race," said one of the coaches. "This water is eccentric and full of challenges."

Iron Oars, cosponsored by FOCR and the Chicago River Aquatic Center, is the longest smooth-water sculling race in the world, covering a distance of fifteen miles. The rigorous event draws contestants from all over the United States who, no doubt, think their oars are made of iron by the end of the long race.

"Friend" David Jones of the Department of Energy and Natural Resources points to the tradition of dyeing the river green every St. Patrick's Day in a well known salute to the city's strong Irish roots. A less well known and more solemn event is the annual tossing of sins (written on small pieces of paper) into the river as a small enclave of Jews on the North Branch atones each Yom Kippur.

Where Does the River Run?

The Chicago River is often described as about one mile long, extending from the Apparel Mart at Wolf Point to Lake

(continued on p. 24)

Summer's end on the North Branch—a natural water trail (Courtesy Ralph C. Frese, Chicagoland Canoe Base, Inc.)

A Wilderness Surrounded

"You don't hear nearly enough about what's happening on the North Branch of the river," protests Ralph Frese, president of the Chicagoland Canoe Base and a river advocate since the 40s. "I see all those bumper stickers that say, 'Escape to Wisconsin.' Parents teach their children to be experts on Wisconsin, but they have no idea what's in their own backyards."

Frese is a blacksmith, a builder of canoes, and proprietor of a boating equipment store. He builds birch bark and dugout canoes and hopes to establish a museum with his collection of 70 native and antique canoes. "This country was discovered and settled by birchbark canoes not covered wagons," he insists.

He enjoys floating down the North Fork when water levels are high in spring or after a heavy rain. "This is the last refuge for a variety of wild creatures in search of a secluded habitat," he says.

In the woods, from his canoe, he has seen deer, raccoons, and a wide variety of water fowl. There are rumors of bobcats (a threatened species in Illinois), but he doesn't claim to have seen one himself. "Every month of the year, the river puts on a different dress," he continues. "Last New Year's Eve, we went out on the river and it was like floating through a living Christmas card. Half a foot of snow on the ground, the water black as ink—out of the wind, and not a sound. I saw probably 40 raccoons playing along the banks."

The first sign of spring along the North Branch is skunk cabbage, poking green leaves up through the snow. April and May bring crowds of wildflowers and, says Frese, "about a million shades of green." In the fall and spring, the river is a peaceful place to watch the migration of birds. "The herons are there then. During the summer months they go farther north," he explains.

"The maples and oaks hang over the banks of the river," continues Frese, "and with the sun streaming through their leaves, they look like stained glass windows."

It's a natural 20 mile-canoe trail—a wilderness in the middle of seven million people.

Mapping Illinois

by William Furry

To the casual observer driving from Chicago to St. Louis on I-55, Illinois is a flat expanse of shapeless prairie. To geologists who study the Illinois landscape, however, those flat, fertile prairie fields represent the tip of a vast geologic iceberg. Buried beneath the rich Illinois soil is a mountain of strata. Herein the history of the state—from its volcanic beginnings more than four billion years ago to the last retreat of the glaciers some 10,000 years ago—is chronicled in layers of sediment. Under frozen fields of winter wheat are prehistoric coral reefs. Here the fossilized remains of crinoids or ancient sea lilies, the harvest of eons past, lie in beds of solidified mud. Here, too, are primordial swamps and river beds—valleys where waters of antiquity gouged channels through solid limestone millions of years before the first mammals appeared on the continent.

But what does all this substrata have to do with those of us who make our home on the topsoil? Illinois geologists have long known that strata formations beneath the prairie soil have a direct bearing on what happens at the surface. All too often, however, the geology of a region is overlooked when developers and planners decide to break ground for a waste disposal site. The results have occasionally been costly for the state. Of the thirty-four Illinois toxic hazard sites on the Superfund national priority cleanup list, seven are municipal landfills. Placed in geologically unsuitable areas, where the risk of groundwater pollution was high, these facilities poisoned both land and water resources.

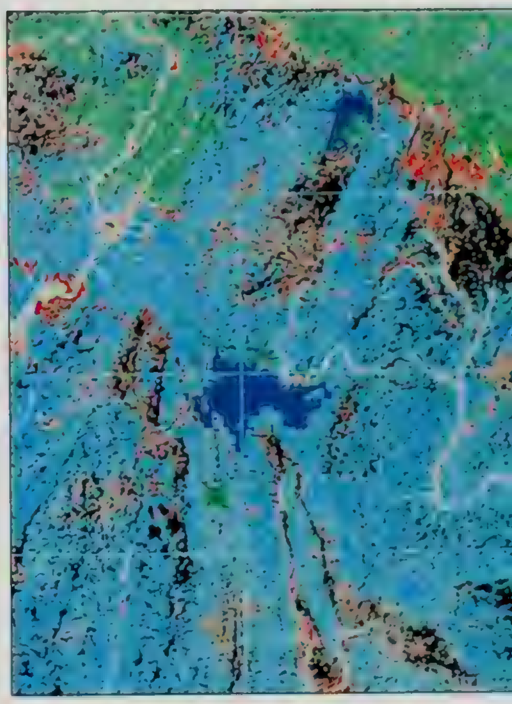
Geologists at the Illinois State Geological Survey are finding new ways to assess geologic conditions beneath the state's surface to forestall environmental hazards on future projects. Using a combination of traditional field study and modern computer technology, they are providing the essential topographical data to help communities deal with the problems of the present while protecting the state's natural resources for generations to come.

Armchair Geology

The Natural Resources Building on the Campus of the University of Illinois is a handsome, Georgian-style structure built back in the thirties by the Works Progress Administration (WPA). The long, four-story facility takes up a city block and houses the Illinois State Geological Survey (ISGS) and the Illinois Natural History Survey. Late on Friday afternoons during the fall season, Survey employees listen to strains of the rehearsing Illini Marching Band as it makes its way across the parking lot.

The ISGS takes up most of the east portion of the Natural Resources Building. Visitors to the first floor are greeted by some of the terrestrial wonders of geology. Displayed here are glass cases filled with a plethora of coal samples, stunning fluorspar crystals, and magnificently preserved fossils. On the second floor, outside the ISGS Computer Research and Services Section, the walls are lined with geologic maps and colorful printed diagrams.

Robert J. Krumm is an associate geologist in the Computer Research and Services Section of the Survey, who has worked with the Illinois Geographic Information System (IGIS), a relational data-base system, for the last six years. From his chair on the second floor, Krumm commands an unusual perspective of Champaign County. With the aid of the Survey's state-of-the-art graphic computer, he observes the county from the bottom up, starting with bedrock. For the last several months, Krumm and other geologists have been using the $135,000 computer to prepare three-dimensional maps of Champaign County—maps that will help county officials site a new landfill.



Champaign County map shows materials at a depth of about 5 feet. Fine-grained glacial tills (green and blue) are favored for landfills, while coarse sand and gravel deposits (red) are to be avoided.

"Geological mapping is concerned with describing and representing subsurface materials that cannot be readily observed, " says Krumm. With the aid of this new computer technology, geologists can simulate the removal of succeeding layers of strata from the surface of the county all the way to its bedrock floor. For Krumm and the other geologists who worked on the mapping project, what's *below the surface* of the county is far more interesting than what lies *at the surface*

Unlike southern and northwestern Illinois, where much of the bedrock topography is exposed at the surface,

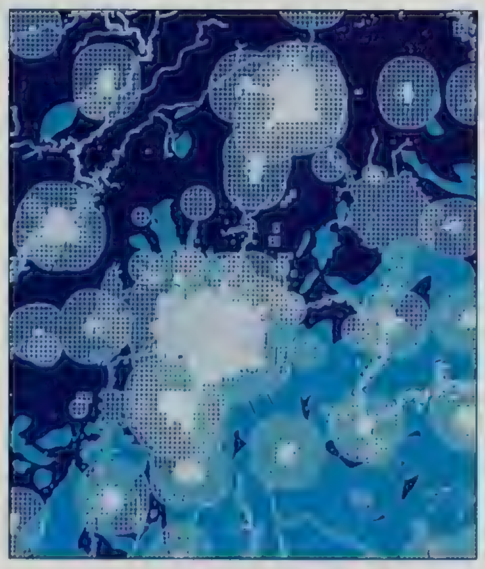
Champaign County has no exposed bedrock. Before the last million years of geologic history in the state, most of Illinois' surface topography resembled that of Jo Daviess County and southern Illinois south of Carbondale. Large river systems and various erosional processes incised the limestone valley floors, gouging canyons and valleys in the bedrock in a process that took millions of years. When the glaciers came down from the north, they filled up bedrock valleys with glacial debris—sand and gravel, a fine-grained clay material geologists call "till," and loess, a fine-grained wind-blown dust at or near the surface.

Until recently, mapping the bedrock surface of the state has been the task of traditional geologists who painstakingly analyzed individual core samples from drill sites and prepared maps based on the data collected. "Basically, what you are looking for in preparing a bedrock map is the first description of rock in a bore hole," explains Krumm. "From that point you determine the elevation, plot those points on a map, and then draw your contours accordingly."

For the Champaign County project, all known geologic descriptions of the county were entered into the computer's data banks. This information came from 3,000 well logs, which are records of water well drillers' descriptions of bore samples. Although some of the logs were over half a century old, the records are still considered reliable. More than 50,000 separate bits of information were fed into the computer, including the locations of all known water wells in the county. More than 1,000 square miles were included in the study.

(opposite) Maps from 14 separate layers were combined to show the thickest sand and gravel (violet) in the northwest part of the county, the thinnest (black) in the southeast. Aquifers (violet and dark blue), water-bearing pools located in sand and gravel substrata, are eliminated as possible landfill sites.

The computer software used in creating the ISGS's three-dimensional topographical studies is little more than a year old. It was created by a company called Dynamics Graphics. To most geologists it's all pretty new, although the U.S. Bureau of Mines and many oil companies have found the technology useful in locating new seams of ore and pockets of natural gas and oil. The system requires two computers to run the software, programs called Interactive Surface Modeling (ISM) and Interactive Volume Modeling (IVM), which, when programmed simultaneously, produce the distinctive three-dimensional image. The system requires sixteen megabytes of memory and handles more than one million instructions per second. Geologist Krumm emphasizes that, "It's not how much memory a system has, it's how fast it can do the job." Paul DuMontelle, branch chief for the ISGS's Environmental Geology and Geochemistry Branch, says the new computer systems have changed the way geologists will study the earth. "Had this technology existed five years ago, it would have cost the state millions to install. Because of cheap memory and very, very well-thought-out computer programming, it has opened up a whole new world at a fraction of the cost."



Areas of widespread thick aquifers (dark blue) were excluded from consideration as landfills, as were 100-year floodplains, wetlands, urban areas, airports, and state-owned lands (white). Areas for further investigation have been identified (light blue) in southeastern Champaign County.

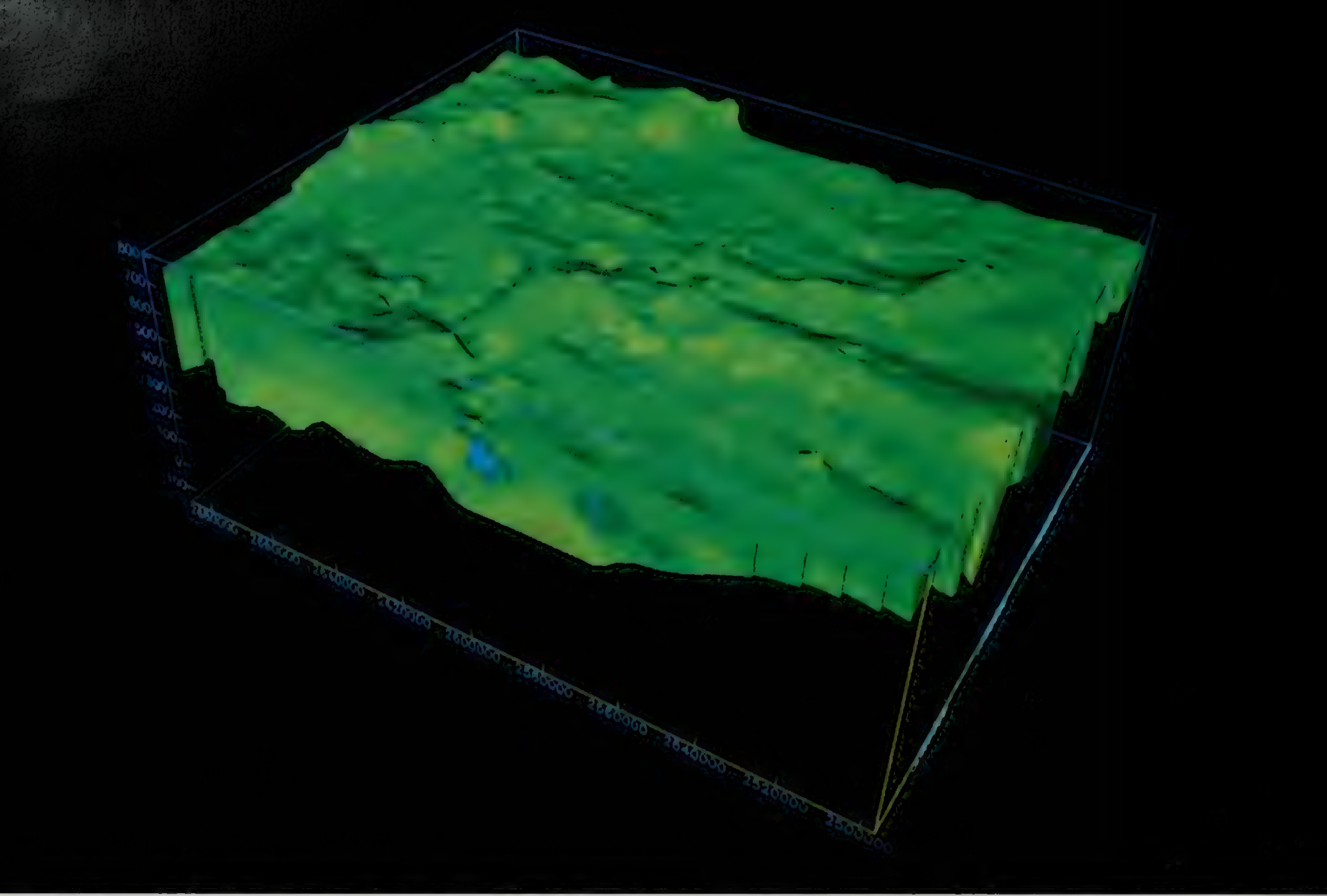
Present Needs

The most pressing need for studies like the Champaign County project is in the area of landfill siting. Illinois has mandated all counties with a population of over 100,000 to come up with plans for the disposal of solid waste by 1995. Geologists at the ISGS are working with Lake County officials to help them locate a site for a new landfill. Several other counties are in various planning stages. The Survey also prepared a similar computer map for the state Department of Nuclear Safety of the proposed Martinsville low level nuclear waste storage facility in Clark County.

"There's a tremendous need for mapping," says Richard Berg, head of the Groundwater Protection Section of the Survey. "The problem in Illinois is that there are very good maps providing regional information, but no detailed maps for specific areas. Regional maps help us prioritize what areas of the state are in greatest need of mapping—but to actually identify and solve problems, more detailed, site-specific maps are necessary."

One of the most important areas of research at the Illinois State Geological Survey is the need for delineating aquifers—water-bearing pools located in the sand and gravel substrata.

According to Paul DuMontelle, scientists in the Groundwater Protection Section of the Survey are closely monitoring groundwater contaminants caused by landfill leachates, a pollution problem that has plagued the northern Illinois counties of Boone and Winnebago. "Protecting groundwater resources is a long-term project for Illinois," says DuMontelle. "The new computer facilities provide us with very rapid ways of responding to questions about bedrock surface, about



IVM software creates a 3-D model. Darker green and blue indicate fine deposits.

drift thickness, and about the availability of water for a specific community. The Geographic Information System not only graphically illustrates that information, it does so in a spatial manner." The new computer system also allows operators to update the data banks as new information is generated so that maps can be revised instantaneously.

Computer mapping in Illinois is still in its infancy; it will need to be verified through practical applications. In areas of the state where water-well logs are sparse or unavailable, data are often unreliable and will remain so until sufficient core samples are taken. In southern and northwestern Illinois, where bedrock is exposed at the ground surface, more traditional methods of mapping permit collection of information on bedrock without drilling.

But as the state struggles to come to terms with the problems of waste disposal, mapping—both computer and traditional methods—will play a major role in determining where and how Illinois will deal with the problem. "Maybe geologists are biased, but the geologic information and setting is crucial in locating either a landfill or a hazardous waste site," insists geologist Krumm. "If the natural environment isn't there to support it, the only alternative is to design a solution. Unfortunately, there are a lot of facility siting decisions made without taking into account the geology of the area."

How Much and How Soon?

According to James Eidel, Principal Geologist and Branch Chief for the Mineral Resources and Engineering Branch of the Survey, a cost-benefit study of geologic mapping in the state will form the integral part of an ISGS report to be presented to the Illinois Senate in early 1991. This report will outline funding requirements for a detailed mapping program for the state. "It would cost the state on the order of $50 million to remap the state," says Eidel. "The American Association of State Geologists drafted a federal bill to introduce mapping legislation to the Congress," Eidel says. "The legislation will request up to $35 million per year for mapping of the United States. We are hoping that Illinois will provide up to $1 million per year and that the state dollars will be matched with federal dollars. If we had that money now, we could completely remap the state at the detailed scale of 1:24,000 (one inch equals 2,000 feet) in about twenty-five years. That's the kind of effort we are talking about."

The next time you drive that stretch of I-55 from Chicago to St. Louis and find yourself staring at the vast expanse of shapeless prairie, you might want to keep this in mind: To really get to know Illinois, you've got to start at bedrock and work your way up. ■

William Furry is a regular contributor to ***The Nature of Illinois*** *and a staff writer for the* ***Illinois Times*** *in Springfield.*

All maps courtesy ISGS

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creature
has a part
to play
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IF is a not-for-profit corporation formed in 983 to foster an understanding of and ppreciation for the natural resources of inois and to promote the activities and esearch of The Illinois Scientific Surveys Jatural History, Water, and Geological) and ie Hazardous Waste Research and formation Center. These four agencies, nder the Department of Energy and Natural esources, have earned the respect of :ientists and government officials well eyond the borders of Illinois.

. . the public and private sectors working ɔgether to enhance the quality of life and nsure a healthy economic future for the tizens of Illinois.

embership application follows page 16.

awing of Red Fox © Courtesy Beverley Sanderson
ampaign, Illinois

URVEYING ILLINOIS

IS)

ter-intakes of power plants 1 water-treatment facilities. ey pose a threat because they : prodigious multipliers and :y compete for food with ne fish and with native mid- stem mollusks.

INHS will convert a rtion of the Lake Michigan ɔlogical Station to analyze lections of zebra mussels 1 will pursue outside funding establish a research and ıcation program.

Used with permission, Detroit Edison

Raptor-ous Call Stirs Birds

The call of the great horned owl is being broadcast by INHS researchers to help them take a woodland census. Several species of woodland raptors (birds of prey) are currently listed as endangered in Illinois, but little is known about the abundance and distribution of these and other woodland hawks and owls. The owl call causes defensive behavior in nesting raptors—it stirs them up and they fly from their nests to look for the "owl"—making them easier to count. Results from twelve study areas throughout Illinois will be used by the Endangered Species Protection Board to determine which species should be added to, removed from, or retained on the state's list of threatened and endangered species.

Fore! Grub Control Studied

Annual white grubs, the main pest of turfgrass in Illinois, are currently controlled with chemical insecticides. There may be a better way. Some species of nematodes (parasitic worms) can penetrate insects that live in soil and other moist areas and release a lethal bacteria. The effectiveness of these nematodes in controlling annual white grubs is being tested in the laboratory and on a golf course. Results will help determine whether these biological control agents offer a practical alternative to chemical insecticides.

cently, Survey researchers ve linked these declines to a luced food supply (primarily gernail clams, snails, and ıyflies). To date, an unknown :in associated with sediments ; been implicated in these :lines. A project currently derway seeks to identify the lprit and its source. Toxicity the sediments increases stream into the Chicago :tropolitan area and may int to a common aquatic :icant, ammonia.

The Illinois River (INHS photo)

CURRENTS

Illinois State Water Survey (ISWS)

Can this area be saved?
And will the airport get off the ground?

The heavy hitters of science and the environment (HWRIC, ISWS, and The Illinois-Indiana Sea Grant Program) sponsored a conference last May to further scientific exchange and public awareness. The topic: "The Lake Calumet Area: Environmental Concerns."

Intense scrutiny of the region is due, in part, to discussion (and controversy) over a proposed third airport for Chicago. More than 100 attended the conference to hear area policymakers, government representatives, and environmental specialists and scientists.

Well into the late nineteenth century, shallow lakes, sandy ridges, and marshes supported rich populations of waterfowl and other wildlife in this area to the southeast of Chicago. Over 100 years of manufacturing, industrial waste disposal, dredging and landfilling, however, have resulted in an accumulation of hazardous substances, destruction of animal habitats, and a drastic reduction of wetlands. A not-so-pretty picture emerged at the conference: groundwater contamination from open wells, abandoned but not properly sealed; surface water with concentrations of toxic metals well above established water quality standards; and toxic air with elevated levels of chromium (a known carcinogen) and manganese.

The two-day conference provided scientists, government officials, business, and environmental activists a rare forum for sharing ideas. A reprint of reports presented at the meeting is available from HWRIC, One East Hazelwood Drive, Champaign, IL 61820; (217) 333-8940.

The Sorcerer's Apprentice

"Like the Sorcerer's Apprentice, we have manipulated nature to serve our needs and desires without fully anticipating the ramifications and without knowledge of how to reverse the process," warned Leo R. Beard, at the inaugural address of the William C. Ackermann Distinguished Lecture Series in Water Resource Issues.

Mr. Beard is senior consultant with the Austin, Texas, engineering firm of Espey, Huston & Associates; emeritus professor of civil engineering from the University of Texas at Austin; and retired director of the University's Center for Research in Water Resources.

He pointed to the folly of meeting every emergency with new controls and discussed a framework for resource management. "We know we can never have complete freedom, especially freedom that impacts adversely on others...there are good ways and bad ways to constrain freedom, and these could be called persuasion and force. Civilization has been defined as the triumph of persuasion over force." Mr. Beard concluded: "Let us keep it that way."

The Ackermann Distinguished Lecture Series is co-sponsored by the Water Survey and The Nature of Illinois Foundation and supported by the William C. Ackermann Memorial Endowment Fund. Ackermann was Chief of the Illinois State Water Survey from 1956 to 1979. For reprints of the Beard lecture, information on future lectures, or to make donations to the Endowment Fund, contact The Nature of Illinois Foundation, 208 South LaSalle, Suite 1666, Chicago, IL 60604.

Mr. Beard with Mrs. Ackermann at the inaugural address of the William C. Ackermann Distinguished Lecture Series (ISWS photo)

Water Supplies in Jeopardy

As many as ten public water systems in Illinois may be unable to meet average daily needs if faced by a 20-year drought (a drought of a severity expected an average of only once every 20 years). Ten additional systems are at risk if a 50-year drought should occur. The primary reasons for impending shortages are reduced capacity of reservoirs and population growth and industrial expansion.

Dr. Krishan P. Singh (Principal Scientist) and Sally M. Broeren, P.E. (Associate Professional Scientist), with the ISWS office of Surface Water Resources and Systems Analysis, conducted the study and are now developing recommendations for the most economical ways to head off future water shortages. They are looking into strategies such as drilling groundwater wells; raising dam levels; and dredging, venting, or flushing sediments from reservoirs.

GEOGRAMS

Illinois State Geological Survey (ISGS)

Scientific Rock 'n Roll

The greatest seismic risk to residents of Illinois is from an earthquake in the New Madrid Seismic Zone outside the state's boundaries, according to a new report prepared by geophysicists at the ISGS.

Environmental Geology Note 133, "Seismicity of Illinois," written by Drs. Paul C. Heigold and Timothy H. Larson, reviews the effects of the 180 known earthquakes that have occurred within the state during the last 193 years. It also compares the size of the earthquakes within Illinois to those that have occurred just south of the state within the structure known as the Reelfoot Rift and considers the likelihood of a large earthquake occurring within the state.

According to the report, the total amount of energy released by all known earthquakes in Illinois is five orders of magnitude *less* than the energy released by the smallest of the three New Madrid earthquakes that shook the midcontinent region in the fall and winter of 1811-1812.

Copies of this publication are available at $1.95 each, including shipping and handling fourth class mail, from the ISGS, Order Department, 615 E. Peabody Dr., Champaign, IL. 61820-6917 or by calling 217/333-4747.

A salvage operator holds the rim of the largest stump discovered so far in the remnant forest found in about 84 feet of water, 15 miles from Chicago Harbor in Lake Michigan. (Courtesy Keith Pearson, salvage diver)

Water-logged History

Submerged tree stumps were not the treasure salvage divers had in mind, but they are a "find" for geologists studying the history of Lake Michigan. Ancient stumps, carbon-dated to 8,300 years ago, provide the first benchmark of where the lake was at that time and offer clues about its fluctuations ever since, according to Dr. Michael J. Chrzastowski, ISGS coastal geologist.

"It was about 8,300 years ago," said Dr. Chrzastowski, "that ancestral Lake Michigan rose high enough to drown these trees. Their location approximates the shoreline at that time, and the excellent preservation of the stumps suggests a history of continuous submergence."

Lake levels have fluctuated widely since the last ice age. About 10,000 years ago, southern Lake Michigan was 200 to possibly slightly more than 300 feet below its present level. About 4,500 years ago, the lake was as much as 26 feet higher than it is today. Finds such as this lake-bottom forest add valuable pieces to the puzzle as geologists attempt to complete the picture of the history of Lake Michigan's shoreline. They pose interesting questions about its future as well.

Spring Field Trips Offered

Take a geological field trip and learn why the state's landforms and scenery vary greatly from north to south. Two trips will be offered this spring—the Fairfield area will be examined on April 20, and the Kewanee area, May 18.

Fairfield, in southeastern Illinois Wayne County, is an area of low surface relief where the Pennsylvanian-age bedrock surface is mantled by a thin drape of glacial drift deposited 250,000 years ago. This is an active oil producing area.

The Kewanee trip will introduce you to Henry County in the northern part of western Illinois. This area lies between a fairly level upland plain and a large, wide, poorly-drained low sandy plain through which the ancient Mississippi River flowed eastward.

To obtain a brochure about these free trips, contact ISGS, 615 E. Peabody Dr., Champaign, IL. 61820-6917, or call 217/333-4747.

Geological field-trippers (ISGS photo)

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

Waste Management in the Laboratory

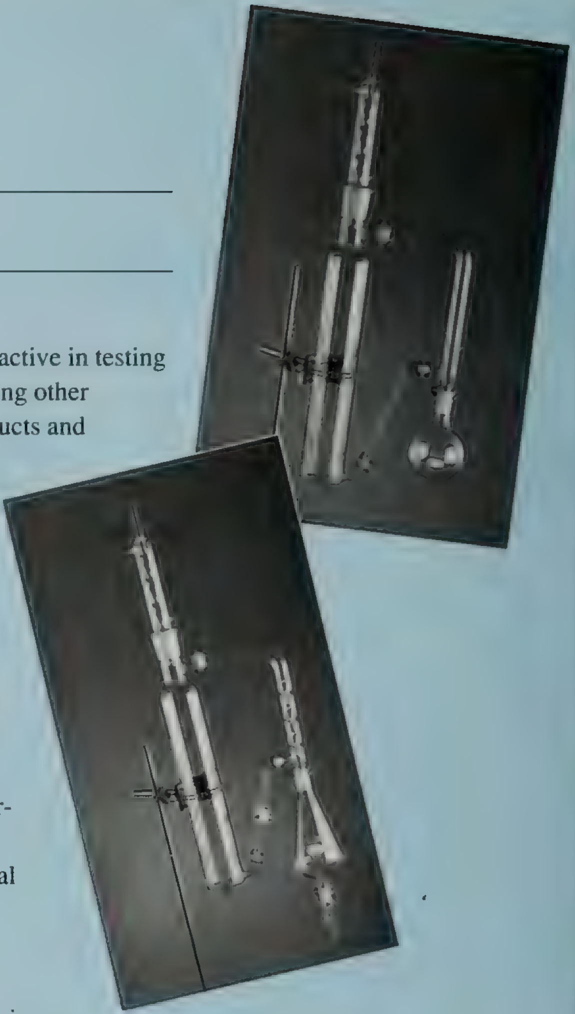
A new kind of laboratory glassware from Corning Incorporated is being tested at the Hazardous Waste Research and Information Center (HWRIC) to ensure that research is part of the waste management solution and not part of the problem.

Sample analysis often involves using toxic solvents that are vacuumed up laboratory fume hoods during the testing process only to escape into the atmosphere—very much like pollutants emitted from industrial stacks. Waste from thousands of laboratory fume hoods across the country can be a significant source of methylene chloride and hexane pollution.

The new Corning glassware is designed with a series of valves that reduces the amount of toxic chemicals that ultimately reach the environment. Equally important, up to 95 percent of the solvent can be reclaimed for reuse—or disposed of in an environmentally sound manner.

"There are efforts now in California," said Dr. Marvin Piwoni, HWRIC Laboratory Services Program Manager, "to clamp down on toxic emissions from labs. This is an idea whose time is now. Laboratories nationwide will soon be affected."

HWRIC is active in testing and demonstrating other innovative products and techniques that limit generation of laboratory wastes. Results are made available to the scientific and academic communities through its clearinghouse and through technical assistance.



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THE FOUNDATION

A Time of Tributes

Dorothy and Gaylord Donnelley were honored at a dinner at the Hotel Nikko in Chicago, November 8, 1990, for their lifetime commitment to the environment. The tribute, initiated by Open Lands and the Upper Illinois Valley Association, was coordinated with the unveiling of the new "21st Century Open Space Plan"—a 1,000-mile network of greenways that will connect the entire nine-county Chicago region and add roughly 23,000 acres of green open spaces to existing holdings in northeastern Illinois.

Dorothy and Gaylord Donnelley

Since 1963, Open Lands has forged partnerships with neighborhoods and legislators, developers and ecologists, to preserve public open spaces. Conservation and environmental groups, concerned citizens, and business leaders participated in the evening's tribute. Gerald Adelmann, Open Lands executive director reported that $430,000 was raised to help launch the "21st Century Plan."

1990
MERIT
AWARD

Foundation Honored

The Nature of Illinois Foundation was one of nine organizations to receive the Soil and Water Conservation 1990 Merit Award for "activities that advance the science and art of good land and water use." The citation commended the Foundation's magazine ***The Nature of Illinois*** and its educational projects for school children.

WHOLESOME WATER IN ABUNDANT SUPPLY

The Early State Water Survey's Urgent Quest

by Robert G. Hays

Turn-of-the-century fishermen on the Illinois River near Havana grew accustomed to a curious houseboat, towed by a 25-foot steam launch named *Illini*. In all likelihood, what went on aboard the vessel remained a mystery to most of them. And even if they had known, they could not have been expected to appreciate fully the importance of what was taking place.

This lumbering craft was no ordinary pleasure boat. It was a carefully designed scientific laboratory, complete with scientists' office, a library, kitchen, and laboratory space. The investigations carried out from this floating biological field station marked the beginning of the scientific study of water pollution in Illinois—almost 100 years ago.

Scientists and students aboard the houseboat during the summer of 1894 collected water samples regularly at six points on the Illinois River and three points on connected lakes. They studied their samples methodically, carefully identifying and recording minute specimens of plant and animal life. Then they sent the samples to the University of Illinois for analysis in the laboratory of Professor Arthur Palmer. Professor Palmer was confident that contaminated water was a major factor in the typhoid epidemics that had devastated the nation in 1893. He was especially eager to gain more extensive information on the quality of drinking water in his home state. Water samples from the Illinois would allow him to commence his urgent quest.

Pioneering a New Science

Arthur Palmer was a chemist—for a time the entire chemistry faculty of the university. He was well ahead of many of the scientists of his day in his understanding of the importance of clean water. Even so, he faced a formidable challenge. Because modern methods of bacteriological investigation had not yet been developed, Palmer could not identify conclusively the origin of outbreaks of typhoid and other dangerous diseases. At the same time, Illinois had few large population centers and had scarcely begun to notice serious sanitation problems. Health hazards that today seem obvious went unrecognized; there was no great public outcry from citizens worried about polluted waters.

But Professor Palmer enjoyed two advantages that significantly influenced his perspective. First, he had done graduate study in Europe, where the sanitary movement had gained a great deal more momentum than it had in the United States. And second, Palmer was a protégé of Stephen A. Forbes, whose understanding of aquatic biology and the complex relationships of natural environments probably was unparalleled in late nineteenth-century America.

Forbes was both State Entomologist and director of the State Laboratory of Natural History. But more important, so far as Professor Palmer was concerned, Forbes also was dean of the University of Illinois College of Science and, therefore, Palmer's boss. That relationship would propel

Professor Arthur Palmer became the Water Survey's first director in 1895. A chemist, he was well ahead of the scientists of his day in his understanding of the importance of clean water (Courtesy ISWS)

Arthur Palmer into the mainstream of scientific activity.

Dean Stephen Forbes was nationally known and respected as a scientist. In Illinois, he was remarkably influential. It was Forbes who founded the Havana field laboratory, a joint undertaking of the university and the State Laboratory of Natural History, and it was Forbes who initiated Palmer's work testing Illinois River water.

Water Survey engineers and local representatives check the flow of a new well in West Frankfort in the early 1900s. (Courtesy ISWS)

In 1895, Forbes succeeded in gaining a special $5,000 appropriation from the state legislature to support intensified chemical analyses of the state's water supplies. Professor Palmer undertook the study in September. He and an assistant, toiling in the university's cramped chemistry laboratory, analyzed nearly 1,800 water samples from 68 Illinois counties over the next 15 months.

Galesburg's city health commissioner sent samples from a number of shallow wells in that western Illinois community. Professor Palmer's analyses showed that the water was contaminated. Subsequent study revealed that most of the wells received drainage from animal refuse. From Jacksonville, where typhoid had been prevalent, samples showed that very few wells provided water the scientists could consider safe. Similar situations were found in Joliet, Rock Falls, and other communities around the state.

Funding a New Agency

At the end of December 1896, Professor Palmer recommended not only that the water study be continued, but also that it be expanded in scope. He knew he was doing important work. The legislators in Springfield responded favorably.

This time, however, the funds appropriated by the legislature were separate from those committed to the general budget of the university. The appropriation bill called for a systematic chemical and biological survey of the waters of Illinois "to the end that the potable waters of the State may be better known, and that the welfare of the people of the various communities may thereby be conserved." A State Water Survey now existed as an institution created by the Illinois General Assembly.

The early work of Professor Arthur Palmer and his assistants was in many respects pioneering. Theirs was an exciting, if somewhat uncertain, scientific period. Most of the water samples analyzed during 1896 were from home water supplies in communities where typhoid and diphtheria had been all too common. The chemical tests performed in Professor Palmer's laboratory were extensive but, he readily admitted, still speculative to some degree. "The precise relationship between the content of nitrates and the dissemination of disease by use of the water in which they are contained, is not definitely known," Palmer explained in his first published *Bulletin.* But he said that scientists in many instances "have found great quantities of nitrates in waters used by families in which several deaths from typhoid have occurred..." He knew his scientific detective work held immense promise.

As knowledge of the new State Water Survey's work spread, demand for its services increased. More than 6,500 water samples had been analyzed by the end of 1899, a third of them sent to the

Dr. Edward Bartow (Survey Director and Chief, 1905-1920) was concerned not only about the ***quality*** *of the water available, but also the* ***quantity****. (Courtesy ISWS)*

A young citizen inspects an analytical field kit used by State Water Survey chemists in about 1910. (Courtesy ISWS)

laboratory by individual citizens who wondered about the safety of the wells and cisterns from which they and their families drank.

Professor Palmer still was interested in surface water, too, and undertook limited studies of the Mississippi, Des Plaines, Kankakee, Peoria, and Spoon rivers and the Illinois and Michigan Canal. And he had not forgotten the Illinois River. For nearly four decades, sewage from Chicago had been carried by the Illinois and Michigan Canal into the Des Plaines River and then to the Illinois. Nor was Chicago the only recognized source of Illinois River pollution. At the turn of the century, Palmer reported, sewage from some 25,000 people in Peoria, 10,000 in Pekin, and 8,000 in various smaller communities was flowing directly into the Illinois.

Added to the human waste was the refuse from Peoria and Pekin feedlots where 40,000 to 50,000 cattle had been fed on distillery slops. At the same time, glucose and strawboard factories in these same cities dumped more than 200 tons of organic waste into the river every day. For one as knowledgeable of the dangers of polluted water as Arthur Palmer, these must have been distressing realities.

It is easy to speculate that Arthur Palmer might have become an eminent figure in American science if fate had granted him that opportunity. But Professor Palmer died in early 1904 of "a physical weakness" said to have been brought on by overwork. He left his successors a clear mandate, however, and it was an appropriate legacy. He had grown adamant in his determination that the citizens of Illinois should enjoy "an abundant supply of wholesome drinking water" and he had gathered indisputable evidence that most of the state's surface water supplies, like its wells, were polluted. And polluted water, Professor Palmer wrote in that first *Bulletin*, offered "a most potent means of developing and spreading disease."

Samuel Parr, a fellow member of the university's chemistry faculty, succeeded Palmer as Water Survey director. He served as something of a caretaker administrator of the growing agency during the next 18 months. (Parr gained recognition later for his studies in the use of Illinois coal, an area of applied chemistry in which he came to specialize.) Then Edward Bartow assumed the directorship. Bartow would guide the Water Survey for the next 15 years, with time out for a stint of active military duty during World War I. He picked up immediately where Arthur Palmer had left off.

Expanding the Mandate

Under Bartow's leadership, the Survey saw rapid expansion of its bacteriological studies. The new director was particularly concerned about small communities that he knew did not have the technical capabilities of the cities when it came to water system management. He moved to make Survey scientists readily available to help. But Director Bartow also believed that the Water Survey should be doing more than simple testing. He felt strongly that water treatment and conservation as well as pollution control ought to be included within the range of the agency's activities.

After a period of lean budget years, Bartow was able to obtain increased funding in 1911 to provide for field engineers to make on-site inspections of municipal water supplies. Their early reports mark the beginning of a water supply data base that continues today as one of the state's valued assets.

Public water supplies in Illinois still were in comparatively primitive condition if gauged by modern standards. Effective methods of chemical purification had been developed in Europe, but these still were rare in the American Midwest. Municipal water systems that pumped raw, untreated water into the homes of citizens were common in Illinois. Clearly, keeping the water clean in the first place would be an important accomplishment, but the Water Survey had no real authority to correct even the most blatant cases of pollution. Pointing out the sources of contamination often proved to be of little consequence. Residents, who were quick to raise their voices in alarm when Survey scientists and engineers pointed out flaws in their communities' water-supply systems, commonly showed little concern about the dangers their own untreated sewage and industrial wastes posed for neighbors downstream.

The need for an intensified attack on pollution was critical. Many of the state's surface water supplies had grown seriously contaminated. Along the shore of Lake Michigan north of Chicago, there were more than 20 sewer outlets along a stretch of shoreline where there also was a score of waterworks intakes. "The frequent outbreaks of typhoid fever along the north shore have made very apparent the dangerous character of this pollution," Bartow reported in a 1913 Water Survey *Bulletin*. The majority of communities drawing their water from reservoirs were making little or no effort to protect them, the report noted, citing the example of one instance where "several private sewers were until recently permitted an outlet in the city reservoir." With very few exceptions, it said, "there are no sources of surface water supply in Illinois that are entirely free from possible contamination of a dangerous character."

Industrial wastes also continued to be a serious and growing menace to the state's waters. Water Survey engineers were dismayed by the condition of the Sangamon River below Decatur, where the stream was heavily contaminated not only by sewage but also by wastes from a corn products factory. Factory waste, said to be six to eight times as strong as normal domestic sewage, was flowing into the Sangamon at the rate of a million gallons a day. In low-water periods especially, pollution from Decatur left the river in a condition of obvious filth for miles downstream.

Water from wells was pumped into the concrete covered collecting reservoir and then filtered and treated at the Dwight Water Plant, c.1914. (Courtesy ISWS)

Early Pollution Control Efforts

Director Bartow had lost patience with the legal limitations on the Water Survey's authority to go to war with polluters. He finally discovered an effective solution. The recently-created Rivers and Lakes Commission had ample power, through hearings and abatement orders, to take action in cases of pollution. But the commission, for a variety of reasons including the lack of funds to hire investigators, had rarely exercised its authority. Bartow jumped at this obvious opportunity. The Rivers and Lakes Commission readily accepted a proposal under which the Water Survey could investigate cases of pollution and report its findings to the commisssion for legal action. Polluters no longer would be allowed to thumb their noses at his agency. The struggle to clean up Illinois water, though barely beginning, at least was under way.

Near the end of his tenure, Edward Bartow defined a two-pronged attack on water problems that he foresaw as the future challenge of the State Water Survey. He told a gathering of the American Public Health Association in Florida that agencies such as his should be concerned not only about the *quality* of water available, but also the *quantity*. The latter element of that dual charge would become critically important for the State Water Survey in years to come.

Professor Palmer, Edward Bartow, and all those who were to follow in molding the Water Survey into the agency it is today, merely extended the original guiding philosophy of Dean Stephen Forbes. On the opening of the Havana biological field station in 1894, Forbes told the University of Illinois Board of Trustees that the university had a special obligation to "stand in the closest possible relation to the general public welfare."

The field station was to carry out a mission of "pure science," Dean Forbes said. But he recognized a broader mission, as well—one best illustrated by the role he assigned Arthur Palmer. In order to serve the public welfare, the institution would have to "work out in every direction the application of the results of its investigations."

That application, ably begun by Professor Arthur Palmer before the turn of the century, continues in the State Water Survey today. ■

*Robert G. Hays teaches communications at the University of Illinois. His book, **State Science in Illinois** (Southern Illinois University Press, 1980), traces the history of the Illinois scientific surveys and their forerunners from 1850 to 1978. This is the second in a series of articles on the history of the surveys.*

UNINVITED HOUSEGUESTS

by James Krohe Jr.

American cockroach

In certain Asian countries, having roaches in the house is considered a sign of good fortune; only the rich, after all, have so much food that they can feed their families and cockroaches, too. The number of cockroaches that people of European descent are willing to tolerate, however, usually ranges from zero to none. A standard British text on the subject, for example, resorts to such unscientific terms as "loathsome" and "abhorrent" to describe the so-called "domiciliary" roaches.

There are many more species of cockroach in the world than most people think are absolutely necessary—3,000 or so. No one knows for certain, and, sadly, we may never know; the vast majority of species dwell, endangered but as yet unidentified, in tropical rain forests. They have been successfully exploiting that environment for eons. Ironstone nodules found near Illinois' Mazon Creek that date from the Carboniferous period (roughly 250 million years ago) bear fossil remains of cockroaches that differ in only insignificant ways from the modern-day creatures.

Myth: For every roach you see, there are a thousand more lurking unseen.

As is the case with most large families, only a few species of the suborder *Blattaria* (which includes all cockroaches) have habits that make them pests. "There were native cockroaches here when the Indians arrived—woodland species like the wood roach (genus *Parcoblatta*)," explains Dr. Philip Nixon, an entomologist for the Illinois Natural History Survey and the University of Illinois Extension Service. These roaches are adapted to Illinois' temperate climate and typically are found outdoors on the floors of our deciduous forests, sometimes in wood piles. Except when winters are very cold, woodland roaches almost never invade houses, whose tropical climate they seem to find too warm and too dry.

That's just as well. The wood roach is a largish insect—about one inch long. It is attracted to lights, so when the males try their wings during spring breeding season, flights of 100 feet or more can take them near, even into, houses. Says Nixon, "You know it when one comes buzzing through the living room."

Making Themselves at Home

However, the cockroaches commonly reviled as house pests are not native to Illinois. Their common names—the German cockroach, the Oriental cockroach, the American cockroach—suggest creatures of cosmopolitan origins. In fact, all the common pest species are creatures of the Mediterranean rim, specifically Northern Africa; as civilization spread, so did roaches.

Like humans, cockroaches have settled virtually every continent without ever straying very far from the tropical environment of their ancestors. Because it loves kitchens, for example, the prolific German cockroach *Blatella germanica* has embarrassed more housekeepers than bad cooking. "If you have roaches in only one room of your house, it will be in the kitchen." Why? They find food there, of course, but also moisture (condensate from cold water pipes inside the walls is a typical source) along with steady warmth and lots of crannies and crevices in which to hide—as close to a tropical forest floor as any environment (that doesn't charge a health club membership) can get. "They say that a happy roach won't move more than ten feet in a lifetime," says Nixon.

The different non-native species common in Illinois are somewhat less tolerant of variations in temperature and moisture, and thus are as picky in their choice of habitat as a new home buyer shopping for the perfect suburb. The Oriental cockroach would rather spend time in a catchbasin than in a king's palace. The brown-banded roach is often found in offices. "We're not sure why," admits Nixon. "It has possibly the lowest need for water among the non-natives. And it likes to hide in stacks of paper"—a trait the insect may have picked up from human bureaucrats.

While cockroaches dwell in groups, they do not nest *per se* nor are they "social" insects like their relatives, the termites. They do

"clump" together in groups, however. A crack that has been visited by one cockroach will be visited by more, who will be attracted to it by the smell of its fellows. They so enjoy company that a live roach prefers to sit next to a dead one rather than sit alone. Nixon says that sticky traps such as roach "motels" work best when there is an already dead roach in it.

Debunking Conventional Wisdom

Because they are so easy to raise, cockroaches have been extensively studied by scientists. The general public, alas, remains uninformed. For example, the presence of roaches is widely believed to be proof of slovenly housekeeping, but like most cockroach conventional wisdom, this is only partly true. Sanitation is important in cockroach control but, while it may impress your mother, it won't impress a cockroach. As Nixon explains, "It is essentially impossible for a human being to starve a roach." The insect is the very definition of "omnivorous." It eats everything human teenagers eat plus animal feces, wood, wallpaper, book bindings, paper paste, and glues. Some species even devour the corpses of their own kind. (They are the ultimate recyclers.)

Effective anti-roach hygiene thus requires that every crumb be wiped up, garbage put into sealed containers, and supper dishes washed before the leftovers get cold. Leaving pizza on the counter overnight is like going on vacation and leaving your front door unlocked.

Many a nightmare has been triggered by another cockroach myth, usually expressed in the form of a maxim: "For every one you see, there are a thousand more you can't see." It is quite true that you will not see more than a fraction of the roaches that may be sharing your dwelling. They are nocturnal, for one thing; for another, they are stay-at-homes—the original crevice-potatoes. Roaches typically feed only once every 24 hours. "They spend the other 21 hours a day sitting," says Nixon. "Even during the night, maybe two-thirds of them aren't active," he adds, and many of those that are active will be foraging unseen inside walls, beneath cabinets, etc. But Nixon estimates that for every one cockroach you sight during the daylight hours there may be only fifty to a hundred others lurking unseen, not a thousand.

Cockroaches are often advertised as carriers of dozens of diseases. There is no evidence that they directly transmit diseases dangerous to humans. And while they have very bad manners for house guests—they stain everything with their excrement—they are as fastidious in their grooming habits as cats.

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Because the German cockroach loves kitchens, it has embarrassed more housekeepers than bad cooking.

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Cockroaches are dirty. More accurately, they *get* dirty, but that's because they share our human habitat. The fact that they frequent sewers, drains, and food-handling areas, means that roaches collect and carry disease organisms that can then be transmitted by physical contact with humans or their food. Most such diseases, like typhus, are a problem only where sanitation is woefully inadequate; in fact, most of the diseases that roaches can carry are no longer encountered in the United States. As Phil Nixon puts it, "If you live in a place where typhus is common, cockroaches will be the least of your health worries."

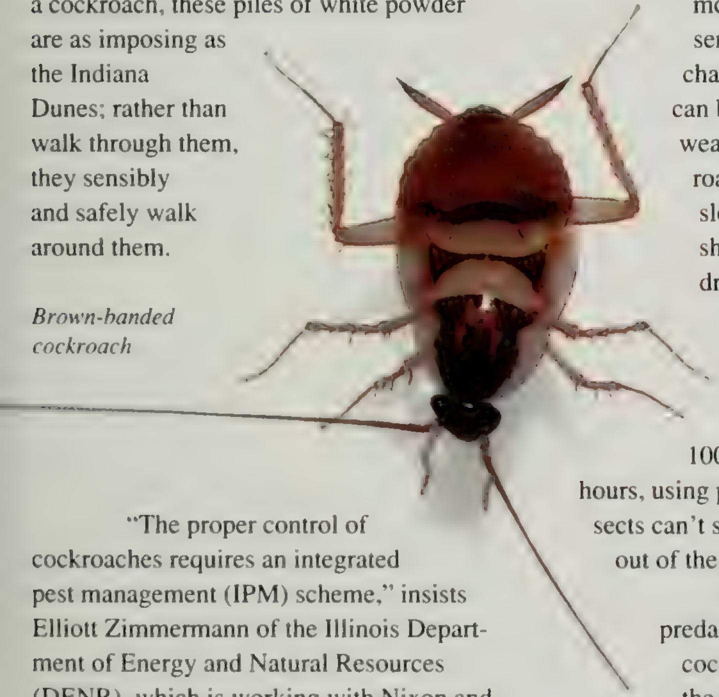
Battling Roach Encroachment

The chemical warfare waged against the cockroach costs millions, but even professional applications of licensed insecticides on a regular basis will not by themselves rid a building of a roach infestation. Less

Woodroach

potent chemicals can work just as well. Boric acid (the crystalline powder used in dilute form as an antiseptic) is a wonderful roach killer—relatively cheap, safe to handle, and lethal for a year or more when spread in roach habitats as a dry powder. Boric acid is picked up on the insects' bodies, then ingested as they lick it off.

It is not known exactly how boric acid kills a cockroach; it may paralyze its gut, or eat away the gut lining, possibly even burn wounds into the creature's cuticle, its hard outer "skin". Boric acid, alas, only works when dry, and when it is dry it cannot stick to any but flat surfaces. It can also spread into food. Some people reason that if a little boric acid is good a lot of it will be great. To an animal the size of a cockroach, these piles of white powder are as imposing as the Indiana Dunes; rather than walk through them, they sensibly and safely walk around them.



Brown-banded cockroach

"The proper control of cockroaches requires an integrated pest management (IPM) scheme," insists Elliott Zimmermann of the Illinois Department of Energy and Natural Resources (DENR), which is working with Nixon and others to devise cost-effective and safe roach control techniques. The IPM approach seeks to use no more insecticide than is absolutely necessary, starting with the least toxic control method available, monitoring the results, and if (*and only if*) roach populations aren't reduced, applying the next most toxic control until an acceptable level of control is reached.

In the case of cockroaches, an IPM approach starts with sanitation and exclusion—sealing baseboard cracks and pipe openings that provide access to a dwelling. The next step is selected use of chemical insecticides in spots where monitoring confirms the presence of the insect. General spraying is expensive and probably unnecessary in all but the worst cases of infestation. DENR is coordinating tests of IPM methods at selected downstate restaurants; at one such location, Zimmermann reports, the roach population shows no signs of rebounding a full year after all spraying has ceased.

New and exotic roach repellents and roach viruses are being tested in laboratories around the country. And because most pest roach species are sensitive to temperature changes, both cold and heat can be effective non-toxic weapons in the war against roaches. Egg development slows and life expectancy shortens as temperatures drop; and a building can be fumigated solely with heat by raising the interior temperature in a closed building to 100 degrees F. for a few hours, using portable heaters. The insects can't stand the heat, and so get out of the kitchen—permanently.

Humans are not the only predator species that threatens cockroaches. The larvae of the ensign wasp (family Evaniidae), for instance, parasitize the eggs of certain species, especially American and Oriental cockroaches. Wolf spiders eat them, as do tropical lizards such as the gecko. House mice also like them. (Most of the cockroach parts found in Illinois fossils are wings, probably because predators typically discard those chitinous body parts as inedible; what survived was the equivalent of fossilized fast-food litter.) Alas, if you have enough mice or wasps or lizards in the house to really make a dent in your roach population, they will themselves become pests.

Both heat and cold can be effective weapons in the war against roaches.

It is often said, begrudgingly, that if *Homo sapiens* ever destroys himself through environmental or nuclear catastrophe, it will be the cockroaches that will take over the earth. You may not be able to prevent that, but Phil Nixon says you may be able to prevent them from taking over your home sweet home. By assiduously caulking and sanitizing and spraying, a diligent housekeeper can rid a house of roaches completely in 6 months. De-roaching an apartment will probably take longer. "If you live in a very large building," he says, "you might as well make friends with them. You'll be moving out long before they will." ■

James Krohe Jr. is a regular contributor to ***The Nature of Illinois*** *and an associate editor at the* ***Illinois Times*** *in Springfield.*

THE ILLINOIS PEARL RUSH

by Ruth Sparks

Freshwater mussels are edible. An excavation in Fulton County, Illinois, unearthed the remains of a 1200 A.D. Paleo-Indian "clambake." Mississippian Indians scooped out a hole in the ground and filled it with layers of hot coals and mussels. (Illinois State Museum diorama, photo by Marlin Roos)

> *"... a mussel can take one hundred grains of worthless carbonate of lime from the water and build it into thin concentric layers, interstratified with animal membrane, until it perfects a lustrous spherical pearl worth many thousands of dollars. At this time when we hear so much about planned economy, it is proper to salute the one real thrifty and wealth producing creature in nature, the mollusk."*
>
> From a 1937 newspaper article by H.H. Vertrees, author of *Pearls and Pearling*

Forty years after the great California gold rush, Illinois had a rush of its own. The quarry in Illinois was not gold, however, but pearls. Like the forty-niners, pearl seekers headed for streams and rivers to search the sand bars and gravel banks. Unlike them, they could not see their nuggets glittering in the clear water, because the pearls were hidden within the shells of freshwater mussels.

An Industry Uncovered

In 1888, J.F. Boepple, a German immigrant, cut his foot on a mussel shell while swimming in the Sangamon River. He was skilled at producing buttons from bone and horn, and this chance accident set him thinking about ways to make pearl buttons from shells.

After some experimentation he succeeded in modifying his equipment to cut out button blanks which could then be polished and pierced. Needing a steady supply of suitable shells, he investigated various locations and finally found a large bed of thick, strong mussels with lustrous interiors in the Mississippi River near Rock Island. He crossed the river and in 1891 opened the first domestic button cutting and finishing factory in Muscatine, Iowa.

The timing was right for his venture. Imported pearl buttons were then so heavily taxed that they were barely affordable to the average person, and church collection plates often included a button among the coins. In addition, large numbers of recently arrived immigrants provided the labor as well as the market for his product. The pearl button industry boomed. By 1899 there were 11 factories in Illinois and 49 in neighboring states that produced finished buttons. In addition, hundreds of small enterprises sprung up in sheds and garages. These family-run businesses produced blanks which were sold by the bucket-full and shipped to finishing factories by the tens of thousands.

Demand Threatens the Supply

The pressure on the mussel beds was enormous. Especially sought after were the larger, heavier-shelled species with such fanciful names as ebony shell, mucket, butterfly, and pocketbook. They were collected in great quantities. One productive bed in the Mississippi River near New Boston (Mercer Co.), Illinois, measured one and one half miles long and a thousand feet wide. It yielded 10,000 tons or approximately 100 million individuals in three years.

It is impossible to know how many of the fragile-shelled species were destroyed as people shuffled through shallow waters feeling for large specimens with their feet or as they dredged up load after load from deeper waters.

Occasionally, a Pearl

An added incentive for the mussel diggers was the occasional gem-quality pearl found among the discarded meats. Gem buyers often stayed in riverside towns for the

(opposite) Craftsmen have traditionally created works of art–such as these lovely Victorian Era pieces–from the nacre of mussel shell. The craft is being revived today; especially prized for inlay work are species that produce various colors of mother-of-pearl. (Courtesy Marlin Roos, Illinois State Museum)

duration of the mussel season, and some were said to have sent out scouts (or spies, depending on the storyteller) to alert them to that rarest of finds—a perfect round pearl!

A superior gem might net the lucky finder several hundred dollars, but even the irregularly-shaped ones, called baroques, were a welcome find for they could make the difference between a good season and a great one for a mussel digger and his family.

The mussels could not withstand this hunting pressure for very long. Beds were often depleted within one or two years and collectors went farther and farther up- and downstream from Rock Island. Large factories began importing shells from as far away as Minnesota and Tennessee.

Trying to Make Amends

So rapid was the depletion that the federal government directed the U.S. Bureau of Fisheries to conduct research aimed toward restoring the resource. Some significant discoveries were made.

It was learned which specific fish hosts were required by the commercially harvested mussels, as well as a way to nurture glochidia (mussel larvae) artifically. In 1923 a half million small mussels were released into the wild, but it was a drop in the bucket compared to the hundreds of tons of large mussels being removed. Almost as a last resort, conservation measures were established. Alternate sections of the Mississippi River were closed for periods of several years and when they were reopened, previously worked areas were closed.

Button blanks before finishing

Plastic to the Rescue

In the end it was economics and new technology, not conservation or artificial propagation, that saved the remaining mussel populations. The death of an industry proved to be the savior of the mussel beds. Overzealous factories had produced so many button blanks that the market was glutted. The price paid for shells fell so low that it was no longer worth a man's time to collect them. But the final blow was the advent of the highly uniform, unbreakable, and very cheaply produced plastic button. A few die-hards continued finishing the huge backlog of blanks through the 30s and 40s, but early in 1950 the last button factory closed its doors.

A Threat and a Promise from the East

With a few years' respite, some species of mussels made a comeback in formerly depleted areas. But another use for their shells was discovered and, once again, mussels were targeted for harvesting.

The Japanese knew that if a small bead is surgically implanted into an oyster and left for a year or more, the oyster will coat the nucleus with a layer of lustrous nacre until a gem-quality pearl is produced. The Japanese had the oysters and the method but no source of nuclei. The shells of certain mid-western mussels turned out to be that source, and a new pearl rush began.

This time the hunt was for mussels with thick white shells—mussels like the threeridge and the washboard. Since the size of the pearl depends on the size of the bead inserted, the largest shells are the most desirable. A ton of raw shells, which are cut into cubes and then rounded off, will yield about fifty pounds of finished beads ready to be inserted into the oyster.

Fragile papershell (yellow) and Hickorynut (brown) mussels (Courtesy Kevin Cummings, INHS)

The oysters are grown in protected bays in the south of Japan. When they reach a suitable size, they are sold to pearl farms. There delicate surgery is performed. Carefully, the oyster is coaxed open and a tiny piece of tissue from a sacrificial oyster is inserted into the host oyster's soft flesh along with a mussel shell bead.

If all goes well, the speck of tissue will grow around the bead forming a pearl sack, and the oyster will begin secreting the crystalline nacre which will transform the plain white bead into a shining pearl. The process takes several years during which time the oysters are laboriously tended and cleaned by hand. The final yield will be about ten percent perfect round gems. In addition there will be some usable, but irregularly shaped ones, and some rejects. A few oysters will reject the nuclei and produce no pearl at all. Thus, cultured pearls are natural in the sense that they are composed of all natural ingredients; they are artificial in the sense that humans are responsible for initiating and guiding the process.

Research and Regulation

The future of freshwater mussels in Illinois is uncertain. They continue to be harvested by the thousands of tons per year for export to Japan. That may be good for the balance of trade but it does not bode well for the mussel population.

Research in the 1980s at the Illinois Natural History Survey (INHS) indicated that large boat-mounted dredges damaged or dislocated 35 mussels for every one harvested. As a result, this destructive method was outlawed. When economic conditions are poor, large numbers of unemployed workers turn to mussel harvesting to make a living. Illinois Department of Conservation (IDOC) regulations have controlled this threat to mussel beds in recent years by shortening the mussel harvest season to allow more recovery time.

Sedimentation and water pollution also pose a continuing threat to mussel resources. Researchers at INHS, under grants from IDOC, continue to wrestle with sorting out the effects of river sedimentation and toxic chemicals on reproduction, growth, and survival of mussels and other bottom-dwelling organisms.

In 1982 the dead soft tissue of thousands of mussels were found floating downstream in the Mississippi River along a 150- to 200-mile stretch from the Wisconsin border to an area south of Hamilton, Illinois. INHS biologists investigated to try to determine the cause of this die-off. Although several factors were ruled out, the cause was never pin-pointed and in 1986 the problem disappeared just as mysteriously as it had arrived.

INHS malacologist Dr. Richard Sparks worries that this die-off may be linked to a larger problem. "During the same period, die-offs occurred in several other rivers in the United States. I wonder if a new contaminant has entered the environment, or a new disease, possibly transmitted by the introduced Asiatic clam." Research continues so that, if a similar event occurs in the future, enough might be known to suggest a remedy. ■

Ruth Sparks, a trained biologist and former science teacher, often works on the river and in the laboratory with her husband, Dr. Richard Sparks, INHS malacologist.

Clam or Mussel?

A Lesson in Nomenclature

(no•men•cla•ture: the act or process of naming)

The mollusks that are collected for commercial purposes in midwestern rivers are not true clams, and are only distantly related to the blue mussels found clinging to rocks along our Atlantic and Pacific coasts. At first glance, the bivalve (two-shelled) mollusks look so similar it is almost natural to assume that the animals are pretty much the same. It is their soft parts and reproductive habits that cause malacologists (scientists who study mollusks) to divide them into separate orders.

The true mussels belong to the Order Mytiloida. All of the members of this Order live in salt water and are found in Illinois only when the more delectable members, such as the common blue mussel, find their way onto our dinner plates.

The true clams—34 different families of them—belong to the Order Veneroida. These include saltwater clams such as quahogs and littlenecks—from which clam chowder is made—as well as the tiny freshwater fingernail clam. Little known, the fingernail clam is one of the more important native animals in Illinois because it serves as a food source for bottom-feeding fish and diving ducks that travel along the Mississippi flyway during spring and fall migration.

Though never growing any larger than your thumbnail, fingernail clams are prolific. Because of their efficient method of reproduction, they have been known to reach densities of 100,000 individuals per square meter. Adults produce both eggs and sperm and after fertilization takes place the eggs develop within the protective shell of the parent. Soon hundreds of mini-adults are expelled to live nearby. They mature rapidly and may produce several generations each summer.

A yellow sandshell gets ready to release packets of glochidia (larvae). (Courtesy Richard E. Sparks, INHS)

The mollusks that fueled the button and cultured pearl industries belong to a third group—the Order Unionoida. All of the unionids (you-knee-ON-ids) live in fresh water, and more species occur in Eastern North America than anywhere else on earth. Their method of reproduction is more perilous than that of the fingernail clam. Some, but not all species, have separate sexes, and mature individuals produce either eggs or sperm. The sperm are shed into the water and drawn into the shells of gravid (pregnant) females where tiny larvae (known as glochidia) are produced. While the larvae of saltwater mussels are free-swimming, the larvae of our native freshwater mussels must find a suitable host, usually a fish, and attach themselves to the gills or fins where they live as parasites for several weeks. During this stage they slowly turn into recognizable juvenile mussels. (Not only must the glochidia find a host but, in many cases, it must be a particular species. For example, the valuable ebony shell cannot reproduce without the skipjack herring).

After they drop off their fish hosts, the young mussels burrow into the mud where (depending on the species) they take from one to 12 years to mature.

(continued from p. 4)

Michigan. Joining that segment, however, are the north and south branches. The North Branch originates north of Chicago near Route 120, midway between Waukegan and Gurnee. Created by glacial activity, the first few miles of the North Branch are not much more than a ditch—sometimes totally dry. It flows southward, making its first turn to the east just north of Foster Avenue, and from there it winds through diverse neighborhoods on its way downtown.

The best known section of the Chicago River is the downtown section. You can see the outlines of Fort Dearborn studded in brass on the sidewalk at the intersection of Michigan Avenue and Wacker Drive. The contemporary Hotel Nikko, located between Dearborn and Clark Streets, is a prime example of the current attitude toward the river. Architects and developers of this luxury hotel encourage pedestrian traffic on their property with a two-level walkway and outdoor cafe on the north shore of the river, and they have shared the cost of a gem of a park on the opposite river bank with the City of Chicago.

The downtown branch of the river is home to Wolf Point where north and south branches converged to form the main channel. There, one can watch ducks, pleasure boats, sightseeing cruisers, working barges, and lift bridges, and view some of the city's most impressive buildings.

The river boasts 52 Chicago-owned movable bridges—not including railroad bridges, or those outside the city limits. Chicago has been a leader in movable bridge design and engineering since the first "gallows" drawbridge was built at Dearborn Avenue in 1834.

Mallard ducks on the North Shore channel

Bubbly Creek, on the South Branch of the river, received the carcasses and manure from the old Union Stock Yards and packing houses—the cause of the odor and bubbling gas that suggested its name. Author Upton Sinclair described Bubbly Creek in his classic novel, *The Jungle*, as "a great open sewer a hundred or two feet wide." Even at this most notoriously polluted section of the Chicago River, there are now sightings of fish and birds— never before seen in that location.

The South Branch is also home to many neighborhoods likely to see significant development in the near future. These include Pilsen—once heavily industrialized and now occupied by Chicago's Mexican community and many of the city's artists—as well as Bridgeport, home of three Chicago mayors since the 1950s.

Around the Bend to the Future

"Perhaps soon when we speak of the 'greening of the river' people will think of tree-lined parks and plazas instead of just St. Patrick's Day," says Beth White. "The Chicago River, to this day, is a working river, but it can work and be pretty too."

Thomas Butts, principal investigator for the Chicago Waterways project, Illinois State Water Survey, says: "The water quality of the Chicago River system has improved significantly over the past 20 years." He credits the innovative programs and continual surveillance by the Water Reclamation District for much of the improvement. According to the MWRD, there were no fish in the river ten years ago; fish that swam in through the locks would die. Today 28 species have been identified.

Public and private interests have forged a powerful partnership. The Chicago River is subject to a dizzying number of governmental units—the city of Chicago, the Army Corps of Engineers, the MWRD, the Illinois Department of Conservation, the Illinois Department of Transportation, half a dozen communities, and forest preserve districts. Added to the mix are groups like the Friends of the Chicago River, the Chicago River Aquatic Center, the Chicago Maritime Society, neighborhood groups, business, and industry.

Everyone agrees that the river is better than it was once upon a time. You can tell by the improvements in the neighborhoods; by the industries and businesses that no longer turn their backs to the river; by the wildlife in the waters and along its shores; by the increased number of people boating on its waters; by the number of events using the river as a focus; by the walking and boating tours that are attracting more and more people; and by the number of volunteers who have become a part of advocacy groups like Friends of the Chicago River.

The once overshadowed sibling is measuring up; Chicago is counting both the river and the lake as valued members of the family. ■

Mike Isaacs is a feature writer for The Pioneer Press. David Foster is an active member of FOCR and edits its newsletter; he works as curator of geography for Encyclopaedia Britannica.

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Spring/Summer 1991

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THE NATURE OF
ILLINOIS

Spring/Summer 1991 - Biodiversity

From the Foundation

More than a century ago the Surveys and their predecessor agencies began to catalog the flora and fauna and the mineral and water resources of our state. Their work helps us appreciate the connections between all living things and makes us marvel at the ways in which geology and climate have interacted to create the wonderful diversity of habitats we enjoy in our state.

And their work goes on—to describe what is still here, to warn us about what is in danger of disappearing, and to tell us what is already gone. (The word they use is "extirpated.") Sound science provides us with the vital information we need to make informed decisions that guard our health and our environment. And our work at the Foundation goes on—to get the message out about the importance of the Surveys and to develop educational projects to raise the level of science literacy of both children and adults.

Beginning with this issue, the Nature of Illinois Foundation Board is making a commitment to break into the recycling cycle. We feel that recycled paper is reliable enough now so that we can maintain the high standards of our magazine. It costs a bit more for the privilege, but we hope that as we (and others) increase the demand, the price of recycled paper will come down.

I hope you will enjoy reading about the natural heritage of Illinois and the history and the work of these unique scientific agencies. And I hope you will join me—you will find a membership form in the pages of the magazine—in supporting the work of the three Illinois Scientific Surveys as well as the Hazardous Waste Research and Information Center (our fourth ally in solving the problems of disposing of the by-products of civilization).

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Flowers and leaves of the white water lily float on the surface of the water, but the fruit ripens below. Blooms are usually open only from early morning until noon.

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Editorial Staff
Jean Gray *Editor*
Michael Jeffords *Photographer*

Design
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Stay In Touch
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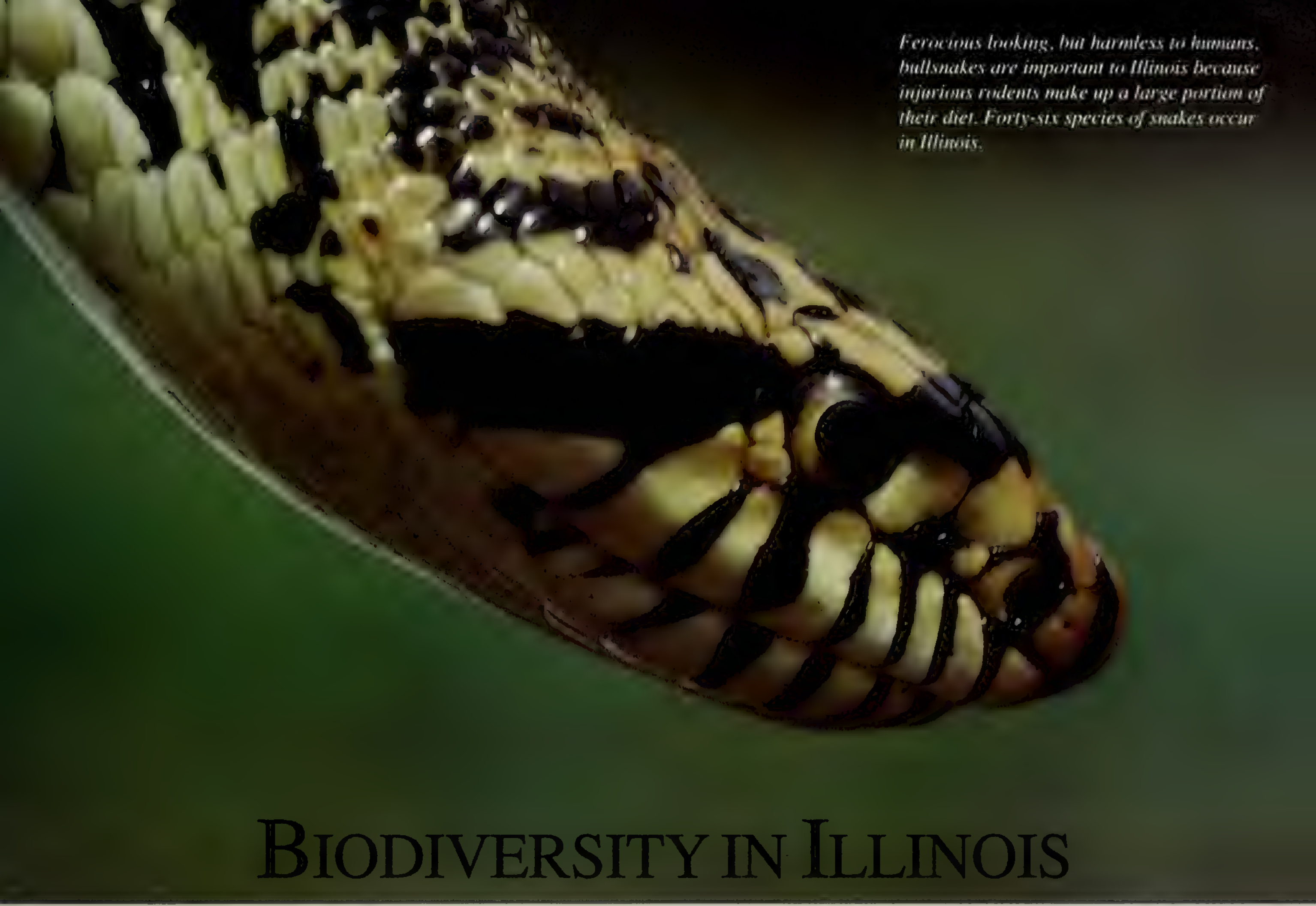


Ferocious looking, but harmless to humans, bullsnakes are important to Illinois because injurious rodents make up a large portion of their diet. Forty-six species of snakes occur in Illinois.

BIODIVERSITY IN ILLINOIS

Today it is not the colliding of continents or the succession of giant ice sheets that shapes the landscape of Illinois. It is the people who live and work in the state that are the significant controllers of the land and its diversity of plants and animals.

Clearly, natural forces continue to interact with the by-products of civilization, but the balance began to shift when the first settlers cleared prairies, wetlands, and forests to grow their food and build their homes. As population grew, so did the demands upon the land. But while change has accelerated at an alarming rate, our 400-mile-long state continues to support a wide variety of habitats and a dazzling diversity of plant and animal species.

Unless things change dramatically, however, in a decade or two we will have lost one in five of our native species of fish and flowering plants, one in four of our native birds and mammals, and one-half of our native freshwater mussels, according to a report from the Center for Biodiversity at the Illinois Natural History Survey.

Scientists in Illinois began the cataloging of species more than 150 years ago. Their work goes on with explorations of biodiversity, conservation biology, restoration ecology, and environmental management—within a framework of social and economic well-being. Today the value of natural ecosystems and the contributions they make to our physical, emotional, and economic well-being is appreciated by a large proportion of the public as well as by scientists.

Education, legislation, and the activities of caring individuals are needed to protect the natural heritage of Illinois. We who live and work in the state will continue to be the significant controllers of Illinois' landscape and biodiversity.

NATURAL HISTORY SURV
JUN 07 1991
LIBRARY

54,000 AND COUNTING

by Susan L. Post

Herring gulls are common on Illinois lakes and rivers, where they are primarily scavengers, but also feed on fish. Their migration is regulated by ice conditions—they need ice to rest on and open water for feeding.

In the mid-nineteenth century few men made their livings as natural scientists. Early cataloging of native Illinois species was undertaken by self-taught naturalists and other amateur enthusiasts, who often spent more of their waking hours studying natural history than at their "bread and butter" work. Examples include Dr. George Vasey, who practiced medicine while botanizing on the virgin prairies of northern Illinois, and Cyrus Thomas, who practiced law while collecting insects. Thomas would ultimately become Illinois' third state entomologist.

In 1853, the formation of the Illinois State Agricultural Society brought these early naturalists together. To encourage the collection of species and the documentation of the state's floral and faunal diversity, the society offered prizes at its annual fair, the predecessor of the Illinois State Fair. At the fourth Illinois State Agricultural Society Fair in 1856, Robert Kennicott, a self-taught naturalist from Cook County, won seven first premiums for his Illinois natural history collections. These included shells illustrating the conchology of Illinois, mammals, plants, birds, reptiles, and twenty-five species of fishes. Each premium paid $10, the same amount paid for prizewinning swine and sheep. Another prize winner of note that year was John Deere, who received two first premiums for plows.

(opposite) The moist, sandy swales of Illinois Beach State Park support prairies inhabited by wood lilies, phlox, and black-eyed Susans that intermingle with sedges and rushes in the moister sites.

Early Species Lists

Three species lists were published in the Illinois Agricultural Society's first transactions of 1855: *The Mollusca of Southern Illinois* by H.A. Uffers of the Illinois Geological Survey, which listed 87 species; *The Birds of Southern Illinois* by H. Pratten, also of the Geological Survey, which listed 184 species of birds from Wayne and Edwards counties; and *The Animals of Cook County* by R. Kennicott, which listed 49 species of mammals, 187 species of birds, 35 species of reptiles and amphibians, 30 species of fish, and 23 species of mussels. His list of mammals included black bear, buffalo, elk, and gray wolf; the passenger pigeon was considered abundant. These five animals have disappeared from Illinois, and the passenger pigeon is extinct worldwide.

Kennicott stressed that his list included only the animals that had been observed within the limits of Cook County. A catalogue of the entire state would increase the list of birds to about 300 and double or triple the number of mammals and reptiles. Kennicott's list of fishes and mollusca was but a small fraction of the number existing within the state.

The first state plant list of 1,052 species was published in 1857 in the second volume of the Illinois Agricultural Society Transactions. Subsequent volumes updated the catalogs, adding 52 species of mammals, 235 species of birds, and 1,184 species of plants. Insects, 5,000 species, were also included.

Natural History Survey Studies Diversity

By the turn of the century, biologists from the State Laboratory of Natural History, later to become the Illinois Natural History Survey, were systematically sampling the state's habitats and adding to the species lists. These early field investigations

There are 17 species of turtles in Illinois. The slider is the species most often seen basking on stranded logs, with many individuals congregating on sunny days. Sliders are found throughout the state, with the possible exception of the far northern counties

The adult Io moth stays up all night and never eats a thing—its only purpose is to mate and lay eggs to begin the next generation. The large eyespots on both sexes probably startle birds or other large predators and keep the moths from being eaten.

formed the basis for understanding these ecosystems and the natural histories of the organisms that inhabited them. The Survey as envisioned by its first chief, Stephen A. Forbes, continues today to catalog the organisms found in Illinois, recording their distributions, determining their life histories, and defining their relationships to each other and to the environment. (See *Science in the Public Interest*, page 13.)

Even today, when we have amassed more scientific knowledge than at any other time in our history, the majority of organisms on Earth remain unknown. In 1990, Survey scientists set about to determine the number of species native to Illinois. The organisms in the Phylum Chordata—reptiles, amphibians, fishes, birds, and mammals—are conspicuous and their numbers are fairly well known. In other groups, however, numbers are far less certain. Research in these groups is at an early stage, and new species are frequently found. Even though the current Illinois list of insects totals 17,000, that number is only an approximation. An even more difficult group to count is the nematodes, parasitic and free-living roundworms that may outnumber even the insects!

A Meeting Place for Species

The incredible diversity of species found in Illinois is more readily appreciated when we compare it to that of other regions. Illinois is host to more than 54,000 species of native organisms. Lying at the junction of the eastern deciduous forest, the western great plains, the southern coastal plain, the Ozark uplift, and the boreal forest, the state provides habitats for organisms characteristic of each of these different geographical areas.

Beall Woods, a remnant of the eastern deciduous forest, is an Illinois Nature Preserve along the Wabash River. It has, in its 270 acres, more than five times the number of tree species found in the nearly three million acres of the Greater Yellowstone Ecosystem. Perhaps equally surprising, one-fourth of all species of freshwater fishes and mussels of North America north of Mexico are represented in Illinois.

A master of deception, the mature larvae of the green-clouded swallowtail butterfly mimics the markings of a rough green snake. The large eyespots are not on the head of the caterpillar but on the thorax. The head is concealed below the body. This is one of approximately 150 species of butterflies found in Illinois.

The Pine Hills-LaRue Swamp region of southwestern Illinois, covering a mere 2,000 acres, contains limestone cliffs like those of the Missouri Ozarks, swampland that mimics parts of Louisiana, and densely wooded coves reminiscent of the Appalachians. It is the most diverse natural area of its size in the Midwest. Represented in its flora and fauna are 35% of the state's species, including 1,000 species of native plants and more amphibian and reptile species (61) than are found in any other region of comparable size in the United States. By comparison, the Great Smoky Mountain National Park, an area 260 times greater, contains only about 1,200 native species.

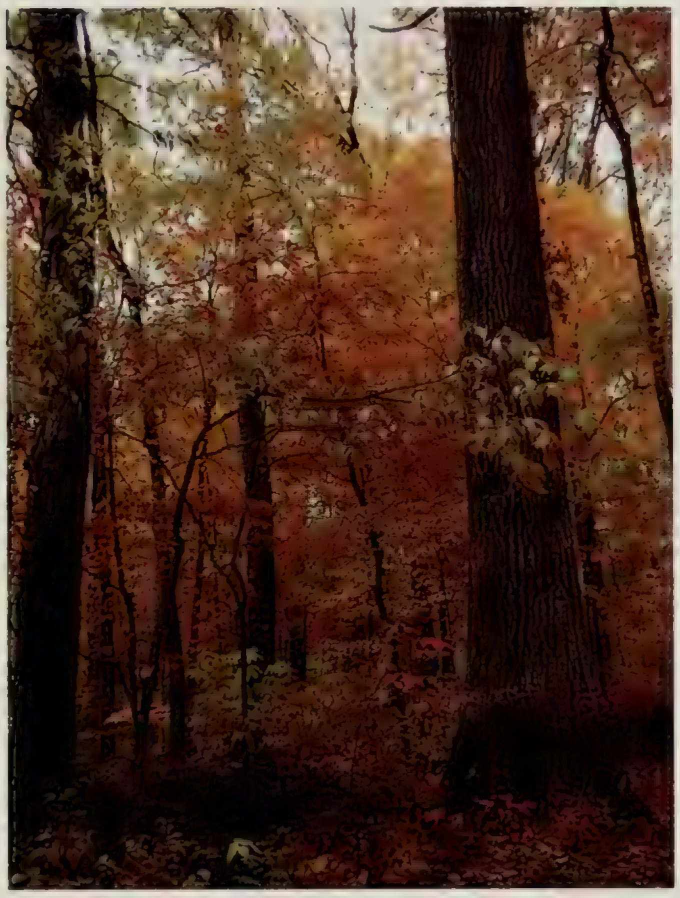
While catalogs and check lists are necessary to record the constant influx of

(continued on p. 24)

PICTURE THE ILLINOIS FOREST

by Louis R. Iverson

Rarely is a photograph of a forest—or even a single tree—chosen to convey the character and landscape of Illinois. Instead, book and calendar publishers show us the classic skyline of Chicago or impressive rows of corn or soybeans stretching to an infinite horizon. A surprising 12% (4.27 million acres) of Illinois, however, is forested. An additional 900,000 acres of land contain significant numbers of trees but are not generally considered forestland. These include the ribbons of trees that follow the course of a stream or create a windbreak along a field. Add to these the trees that line city streets and make up what has come to be known as the urban forest. Taken together, these 5 million acres of land with trees provide remarkable benefits to the citizens of Illinois.



Beall Woods Nature Preserve, Wabash County

Small Parcels, Many Owners

More than 90% of the forests of Illinois are privately owned. Most of the remaining 10% in public ownership is the federally owned Shawnee National Forest in southern Illinois. Each of the approximately 169,000 Illinoisans who own forestland owns an average of 21 acres. Because the Illinois forest has so many proprietors and because their parcels are small, forest management on a statewide scale is difficult to achieve. The fragmentation of the Illinois forest was made clear in a recent study of forest parcel size. Of the more than 10,000 forested parcels larger than 40 acres, about 44% are smaller than 100 acres; only 10% are larger than 600 acres. Fragmentation of forest habitat has troubling implications for wildlife, especially the neotropical migrant birds that breed in the Midwest but winter in the Tropics; a concerted effort must be made to protect larger parcels and consolidate smaller ones.

The Diversity of our Forests

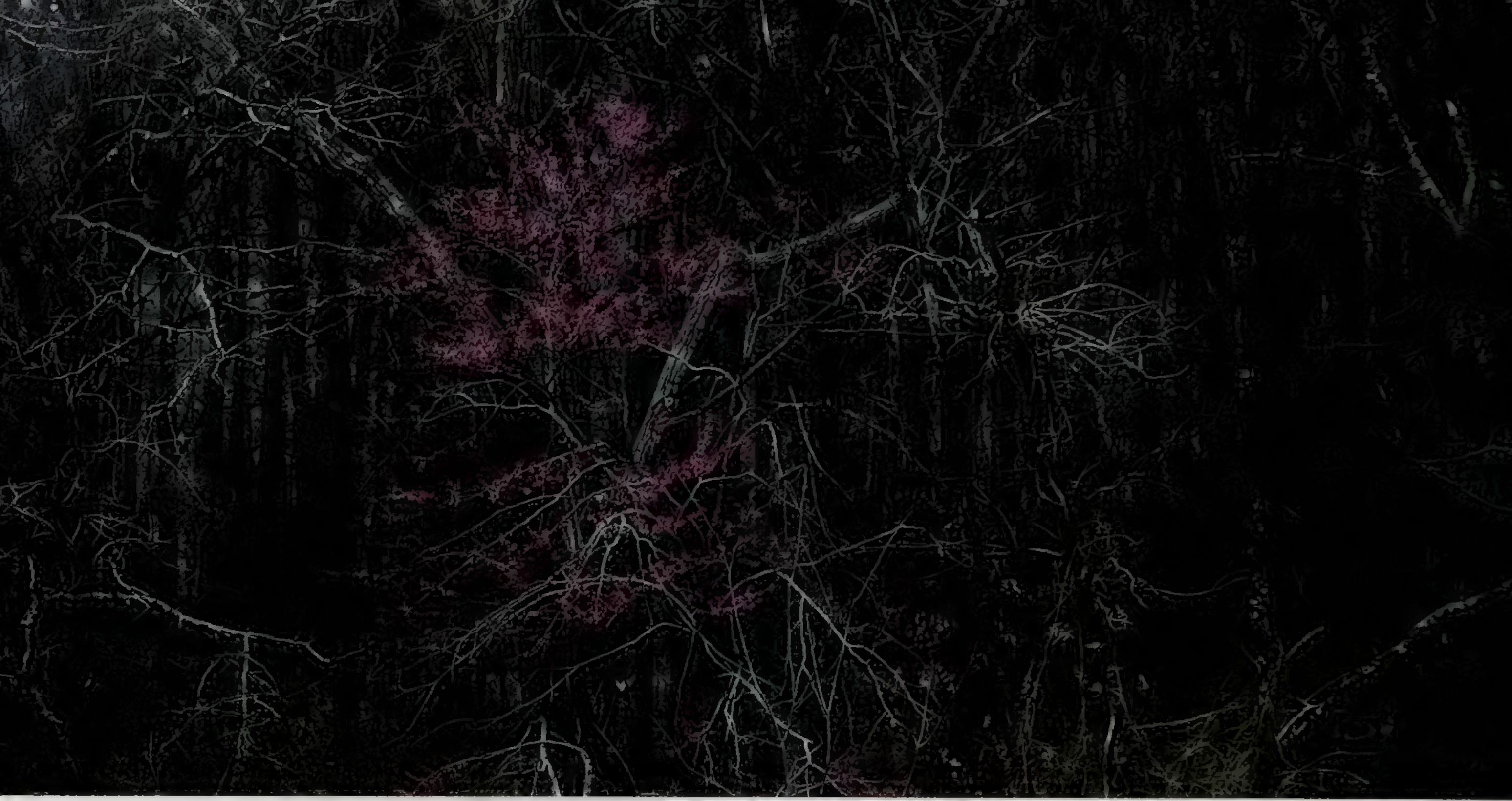
The wide range of latitude between the northern and southern boundaries of the state, a distance of nearly 400 miles, accounts for a considerable range of climatic conditions and a remarkable diversity of habitats. As a result, Illinois supports numerous species of trees—more than 250 have been reported statewide. Oak-hickory forests dominate on about half of the forestland, and these forests are commonly older than 60 years. Young oak stands have difficulty regenerating these days because forest fires are rare, and sunlight must penetrate to the forest floor if oak seedlings are to establish themselves. As a result, oak-hickory forests have diminished by 14% since 1962.

Maple forests, on the other hand, have expanded—an astonishing 4100% since 1962—and now account for a fourth of the Illinois forest. While developing oaks need sunlight, maple seedlings thrive under dense canopies, and so maples are taking over in many areas. A third major forest type, elm-ash-soft maple, is common on bottomlands and accounts for a sixth of the present forest. This type, however, has been reduced by half since 1962 because of the conversion of bottomlands (low-lying lands along a watercourse) to croplands and because of the ravages of Dutch elm disease.

Less common forest types like oak-gum-cypress, oak-pine, and shortleaf pines are confined by climate to the southern counties; white pine is most common in the western part of the state, where it has been extensively planted.

A Look Back

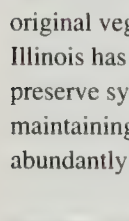
When European settlement began about 1800, approximately 38% (13.8 million acres) of what was to become the state of Illinois was



Floodplain forest with redbud, Pine Hills Ecological Area, Union County

forested. The remainder of the landscape was prairie. By 1860, a flourishing timber industry had been established, and by 1900 the rate of deforestation in Illinois was as high or higher than that of any deforestation currently under way in the Tropics. By 1923 only about 22,000 acres of forestland remained untouched.

Today's forest, covering an area about a third the size of the original forest, is essentially regrowth from cut-over timber. Only about 11,600 acres remain in a relatively undisturbed condition, and only 11% of the state has retained its original vegetation type. Illinois ranks a distressing 49th among states, exceeded only by its agricultural neighbor Iowa, in percent of land remaining in original vegetation type. Fortunately, Illinois has in place a progressive nature preserve system that has succeeded in maintaining remnants of what we once so abundantly had.



Guardian of Biodiversity

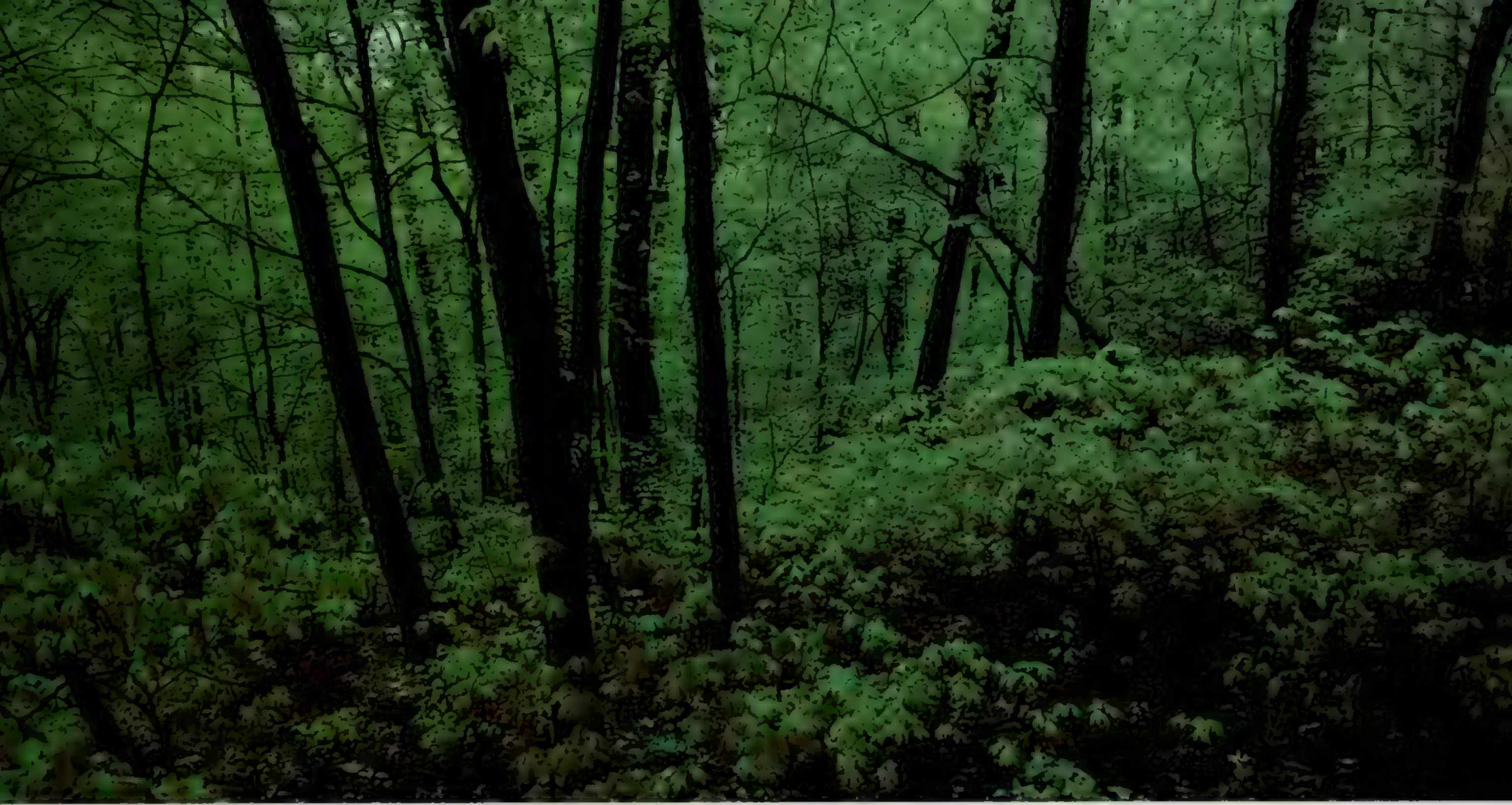
Because row-crop monocultures (single crops such as corn and soybeans) dominate the Illinois landscape—more than 80% of the state is cropland—the biological diversity of our state depends in large measure on our remaining forests. Most native plant species that have somehow managed to find a niche are closely associated with forest habitats: 1,414 of the 2,318 species native to Illinois, fully 61%, are found in forest habitats. A large number of rare plants also survive in forest habitats: nearly half of the 366 threatened and endangered plants of Illinois are found in forest settings. The faunal diversity of Illinois also depends on forests. According to one index, 75% of the wildlife habitat in the state is found in its forests. The forest types of most value to wildlife are mid-aged oak-hickory and old-aged elm-ash-cottonwood, and both have been decreasing dramatically in recent decades. If we are to protect this irreplaceable biological diversity, we must maintain and restore forest communities.

By 1900 the rate of deforestation in Illinois was as high or higher than that of any deforestation currently under way in the Tropics.

Guardians of Soil and Water

For every pound of corn, soybeans, wheat, or oats grown in Illinois today, 3.3 pounds of soil are lost through erosion by water. Soil erosion, with its accompanying degradation of surface water, is a serious threat to the future of an agricultural state like Illinois. Forest vegetation, on the other hand, provides watershed protection and protects against excessive soil loss.

Consider, for instance, that the erosion rate on Illinois cropland averages four times the rate on forestland—7 tons per acre compared to 1.6 tons. The difference is even greater on sloping, erodible soils that lose 24-39 more tons per acre each year they are under cultivation than they would if forested. In 1982, crops were grown on 1.75 million acres of highly erodible Illinois soil. Had those acres been converted to forestland, 36.5 million tons of soil would have been saved—nearly 20% of the total soil loss of the state.



Oak-hickory forest showing maple seedlings in understory. An example of maple takeover.

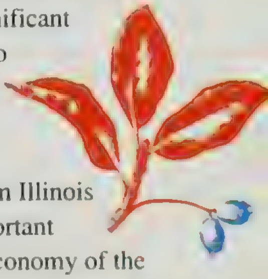
Options under the federal Conservation Reserve Program and the state Forestry Development Act provide financial incentives to convert these highly erodible acres to woodlands. (See *Planting Trees—An Act of Faith*, page 8.) Trees planted as windbreaks and shelterbelts are also extremely effective at reducing wind erosion of soils.

Guarding our Quality of Life

Forests offer opportunities for recreation that can be found in no other setting. In 1987, nearly 19 days or partial days per resident were spent in activities that took place on or near forestlands. Almost every citizen of the state realizes recreational benefits from our forests, and the capacity of forests to renew the physical and spiritual well-being of young and old alike should not be underestimated. Outdoor recreation also contributes significantly to the Illinois economy; in 1987, approximately $6.3 billion were spent by those pursuing recreation in the Illinois outdoors. About 900,000 acres (2.7% of the state) of publicly owned land is available in Illinois for recreation; however, this figure translates to less than 0.1 acre per resident and places Illinois an unenviable 46th among states in public open spaces per resident. To make matters worse, public land is concentrated in southern Illinois and Illinoisans are concentrated in the north.

The urban forest is often the only exposure to a relatively natural environment for many Illinois city dwellers, a group that accounts for 83% of the state's population. And, as a matter of fact, most counties in Illinois have a higher concentration of trees within the city limits than outside! Champaign County, for example, is 1.4% forested, but the community of Champaign-Urbana has tree cover over 27% of its area.

Because of its unique setting within cityscapes, the urban forest provides advantages that are less commonly associated with rural forests: temperature modification and energy conservation, abatement of air, water, and noise pollution, masking of unpleasant views, and psychological and aesthetic benefits. The urban forest also plays a relatively more valuable role in reducing global warming. Because city trees help us to conserve energy, they reduce the amount of carbon dioxide from the combustion of fossil fuels. Indeed, that saving is even greater than the contribution urban trees make by taking up carbon dioxide and releasing oxygen as they photosynthesize. Because each Illinoisan contributes about twenty times the amount of the gases responsible for global warming as the worldwide per capita average, the urban forest of Illinois is truly a significant resource that needs to be expanded.



Timber Economics

Timber products from Illinois forests make an important contribution to the economy of the state. In 1983, 161 million board feet were harvested in Illinois. Forest-related industries employ more than 55,000 people with an annual payroll of nearly a billion dollars. Another two billion is contributed to the economy through the manufacture of furniture and construction materials. An enormous quantity of firewood is also harvested from Illinois woodlots—nearly two million cords a year. In fact, about 43% of the trees harvested in the state in a given year are used for firewood. About three-quarters of the trees cut for firewood, however, come from dead trees so the environmental impact of the harvest is minimal.

With careful management prior to, during, and following timber harvest, most of the other benefits of the forest can be maintained and, in some cases, even enhanced.

A Commitment to Our Future

The forests of Illinois are important to the soil on which the economy of the state is built. They are important to the quality of the surface water in the network of streams and rivers that crisscross and outline our state. Wildlife depends on woodlands for habitat, and many rare and endangered plants make their homes only in the sheltered forest understory. Forests are a vital link in our efforts to slow global warming and to conserve energy.

We in Illinois, like all citizens of this planet, need to become ecologically literate if we are to care for the Earth more intelligently in the next century than we have done in the 20th century. Children are particularly receptive to this kind of education, but land managers and owners must also learn more and volunteers of all ages are needed by the many organizations engaged in activities that directly or indirectly help to protect, maintain, and expand our forests. Many of the natural resources of our fragile planet cannot be renewed; our forests are a magnificent exception. ■

Dr. Louis R. Iverson is a member of the Center for Biodiversity of the Illinois Natural History Survey and the Department of Forestry of the University of Illinois at Urbana-Champaign. Readers who would like to learn more about the Illinois forest should consult the publication from which much of the information in this article came: ***Forest Resources of Illinois: An Atlas of Spatial and Temporal Trends****. This 181-page book and accompanying wall map are available for $4.00 from the Illinois Natural History Survey, Distribution Center, 607 East Peabody Drive, Champaign, Illinois 61802.*

Planting Trees—An Act of Faith

When a farmer plants a crop in spring, he expects a harvest in the fall. When that crop is "forest," however, the harvest can be delayed fifteen years—or even longer.

With the support of the Conservation Reserve Program (CRP) and the Forestry Development Act (FDA), planting forests can be well worth a landowner's time and effort. Combined incentives under these two plans can provide to a landowner reimbursement approaching 100% of his costs. Dan Schmoker, Forest Management Program Administrator, Illinois Department of Conservation, points out that the benefits to society are immeasurable—cleaner air, watershed protection against soil erosion, improved water quality, decreased sedimentation in streams and rivers, enhanced habitat for wildlife, and an additional resource base for future wood supplies.

CRP has helped owners of small land parcels in Illinois plant 14,740 acres of trees since 1986. Under this plan, landowners receive technical assistance for site preparation and planting, advice on types of trees to plant, a cost-share plan for seedlings, and even the loan of specialized planting equipment. Participants are advised on forest land management and ultimately, if they wish, proper harvesting plans for their tree crop. Effective beginning in March 1991, CRP land contracted to tree planting will earn annual rental payments for 15 years. These cash rent payments plus tax savings of from $6-16 per acre per year make an ultimate harvest cost-effective.

Future timber resources and cost-effectiveness aside, Schmoker points out, "There is something to be said for promoting intangible values—like sunsets viewed through the trees in winter, the sight and sound of warblers in the spring and summer, and good clean water in large amounts to provide trout and smallmouth bass the habitat they require."

With proper stewardship, we can enjoy both the tangible and intangible benefits of forested land in Illinois.

For a list of organizations involved in conserving forest resources, contact The Nature of Illinois Foundation.

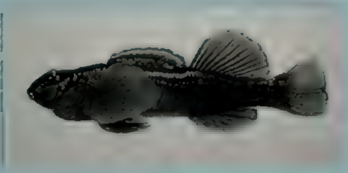
Sunset through the trees (Courtesy Southern Illinois Tourism Council, Carolyn T. Scott, photographer)

SURVEYING ILLINOIS

BIORHYTHMS

Illinois Natural History Survey (INHS)

Peterson Field Guide to Freshwater Fishes



After nine years of preparation, the *Peterson Field Guide to Freshwater Fishes*–the first such guide to include all freshwater fishes known to occur in North America north of Mexico–is nearing release. Authored by Drs. Larry Page, INHS, and Brooks Burr, Southern Illinois University at Carbondale, the book includes descriptions and range maps for 790 species and illustrations for 617 of them. Many are shown in color for the first time. Approximately half the illustrations are by Survey artist John Sherrod. Although the North American fish fauna represents a small fraction (4%) of the world's total, it is the most diverse temperate freshwater fish fauna in the world.

Atlas of Breeding Birds

Survey scientists, in cooperation with the Illinois Department of Conservation and state and local chapters of the Audubon Society, are documenting the species of birds that breed in the state. Over 10,000 square miles of Illinois will ultimately be surveyed in 10-square-mile blocks. From 1985 through 1989, approximately 500 blocks representing 85 counties were visited by volunteers during the breeding season. During 1990, 11 counties were surveyed; the remaining six counties are slated for 1991. All species of birds seen or heard are recorded. Various criteria are used to confirm the breeding status of a species, including nest building, nest occupation, eggshells or other evidence of nest use, and presence of recently fledged young. Currently, the atlas includes 201 species, 163 of which are confirmed as breeding in Illinois.

Endangered Plant Search

About 17% of the higher plants native to Illinois (2,500+ species) are listed as threatened or endangered. Some species on the list are known only through historical records or from a few small living populations. Field searches were made in collaboration with the Morton Arboretum for 137 of these species. Existing populations were found for 57 species, but 71 species were not located. Of the latter, 48 may still occur in the state and will be looked for in future years; the others appear to have been extirpated (wiped out). Such searches are useful to the Illinois Endangered Species Protection Board in revising the list of threatened and endangered plant species.

Nature Photography Workshops

Michael Jeffords (INHS entomologist and staff photographer for *The Nature of Illinois*) and Susan Post (INHS research biologist) conduct photography and natural history workshops at various times during the year. Workshops begin with an orientation and discussion of nature photography, followed by a day of picture-taking in the field. A critique of photographs follows about ten days later. There is a $15 fee for the three-session workshop which is open to all levels of photographers 18-years-old and above. To receive notification of future workshops, call Michael Jeffords (217) 333 5986.

All Bees are not Honey Bees

Although the European honey bee is the most familiar bee in Illinois, the state contains many native bees, including bumble bees, sweat bees, leaf-cutter bees, and solitary bees. Among the most interesting of these are the female solitary ground-nesting bees. This is the only known bee that constructs her own nest and takes responsibility for providing food for her progeny. The largest genus of solitary bees in North America is *Andrena* with some 500 species. INHS Entomologist Dr. Wallace LaBerge recently completed a revision of the genus *Andrena* of the Western Hemisphere with the publication of the last of thirteen major scientific papers.

CURRENTS

Illinois State Water Survey (ISWS)

ISWS Launches Center for Global Climate Change

"Media hype made 'global warming' a household word, but if we have two or three cool years in a row, the media will find a new issue. Policy-makers and the public will go on to the next household word and forget all about climate change. That would not be a good thing."

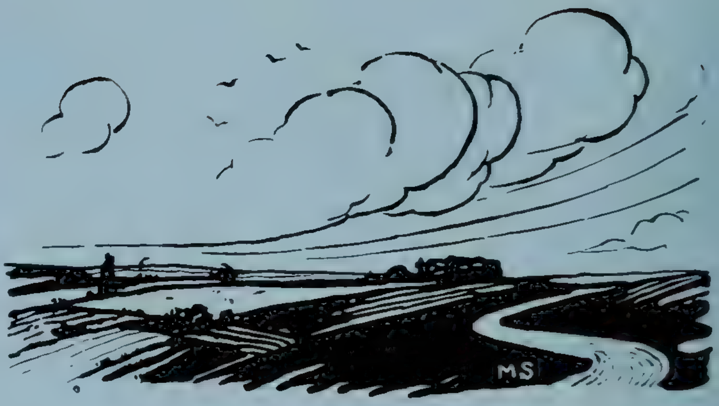
Stanley Changnon,
Chief Emeritus and Head of the ISWS's new Center for Global Climate Change

Jittery weather-watchers have been predicting that worldwide temperatures would rise up to 9 degrees F within the next 50 to 100 years. Although blame is usually leveled at deforestation and the ever-increasing global release of carbon dioxide (CO_2) and other trace gases from the burning of fossil fuels, the drought of 1988 provided the real national momentum for the Global Climate Change (GCC) issue. ISWS joined the five other Regional Climate Centers in the United States last year in authoring a position paper, "Climate Change and the Greenhouse Effect." They suggested that: "The 1988 drought was probably not tied to the ever-increasing atmospheric burden of our waste gas," but that it "...fits within the historical range of climatic extremes over the past 100 years." Their conclusion, however, was that global climate change "is an issue of growing national and international concern."

There is evidence that CO_2 and other trace gases are steadily increasing—up 25 percent since the 1850s, with most of the increase occurring in the last three decades; and global climate models ***do*** predict general warming, increased moisture in the atmosphere, and changes in the regional distribution of precipitation.

What scientists ***do not*** know are the effects of "natural feedback." For example: Would an increase in the frequency and duration of cloud cover—the result of warmer temperatures—act as a cooling "buffer" to reduce overall global warming? Nor are the possible sociological and economic impacts well-understood. Current climate models cannot predict with any accuracy if climate change will occur gradually or in a series of major shifts interspersed with years of little change. While one model predicts that in 50 years Lake Michigan will be two feet lower than the current average, another suggests a decrease of nine feet. These two variations would have vastly different effects on water supplies, transportation, and the economies of the U.S. and Canada.

In response to the potential seriousness and ambiguity of the greenhouse-climate change issue, the ISWS, building on its decades of monitoring and research, has launched the new Center for Global Climate Change. Stanley Changnon, named by Survey Chief Richard G. Semonin to head the project, points out: "Interest and concern is growing. We are receiving more requests for information and scientific guidance on policy issues, and we have provided expert testimony in Congress. The ISWS is gearing its research and data gathering activities to respond to those needs."



The Center will monitor regional conditions to help detect the onset and magnitude of GCC; perform research related to GCC with particular emphasis on analysis of potential impacts (social, economic, natural); and serve as a statewide information service and clearinghouse. In addition, the Center is assembling a sizeable, but rigorously reviewed and screened, collection of reference materials for use by private citizens, business and industry, government officials, and other scientists.

Changnon has already called on three internationally respected research scholars to help Survey scientists formulate research projects: Dr. William Riebsame, Director of the Natural Hazards Center at the University of Colorado; Dr. Michael Glantz, Director of the Environmental and Societal Impacts Group at the National Center for Atmospheric Research; and University of Illinois Professor, Steve Sonka—all world authorities on the environmental and socio-economic impacts of weather and climate.

"It is a tribute to the Survey that three such eminent researchers are eager to work with us as we launch this important project," said Changnon.

Research efforts of the Center for Global Climate Change will involve all three Illinois Scientific Surveys. "It is fortunate that Illinois has three surveys that bracket the natural resources," said Changnon. "Their unbelievably rare and valuable data bases go back more than 100 years, giving Illinois the best foundation for further studies on climate change and for making wiser policy decisions than any other state in the nation."

GEOGRAMS

Illinois State Geological Survey (ISGS)

Snapshot of the Earth—450 million years ago!

Volcanic explosions ripped the earth. Skies were dark worldwide for weeks; ash hung in the atmosphere and circled the globe. Up to 3,000 cubic kilometers of ash fell after these catastrophic events. Compare that figure with the 0.6 cubic kilometer released from the 1980 Mt. St. Helens eruption or the combined volume—55 cubic kilometers—from three historic eruptions: Tambora in Indonesia (1815), Krakatoa in Java (1883), and Mount Vesuvius in Pompeii, Italy (79 A.D.).

Serendipity and good geological detective work brought this story to light about 15 years ago. Dr. Dennis Kolata, ISGS Geologist (Head of Basin and Crustal Analysis), was at work on a project to determine the thickness and distribution of various kinds of rocks throughout the upper Mississippi valley.

"We noticed several persistent clay beds that seemed to appear at the same stratigraphic position," said Kolata. "They were distributed over a wide area—from Rockford to Minneapolis. When we had them analyzed, we found they were K-bentonite, an altered volcanic ash. Because they're so widespread, we conclude that they came from huge volcanic eruptions."

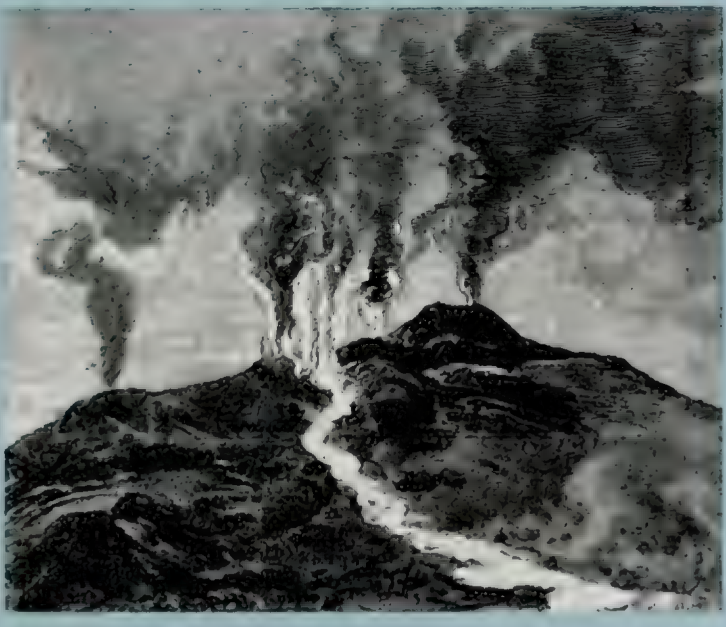
Kolata's initial discoveries grew into a joint investigation with Professors Warren D. Huff, University of Cincinnati, and Stig M. Bergstrom, Ohio State University. The focus of their 10-year collaboration has been on two ash beds traced from Minneapolis to Birmingham to maritime Canada, covering an area of approximately 600,000 square miles.

According to Kolata, 450 million years ago volcanoes were strung along the eastern margin of North America in an island arc system, long since destroyed by colliding continents and erosion. In this time of intense volcanic activity, North America straddled the equator and was submerged in a warm shallow sea teeming with an abundant tropical marine fauna and flora. Only the ash that fell into watery environments was preserved and accumulated as ash beds. Ash that fell on land was washed away.

Aware that ash beds of the same age occur in Baltoscandia, the team traveled to Estonia, Sweden, and Norway in August 1990 to continue their geological detective work. "Early analyses suggest," Kolata said, "that these beds may have originated from the same source as those in North America. They are clearly more widespread than we first suspected. Now," cautioned Kolata, "we have to do the careful analytic work to test the hypothesis."

Tracking a Volcano

Each ash bed has a unique chemistry, so chemical fingerprinting is one technique for tracing individual ash beds over long distances. The volume of the ash deposited is estimated from the thickness of the K-bentonite deposit as measured in quarries, roadcuts, and drill holes. Coarser ash, which falls to the earth quickly, can be found in beds up to five feet thick near the volcano's center. Finer ash carries farther, and layers become thinner toward the outer limits of the ash fall.



"The explosive volcanic activity that produced these two ash beds must be counted among the greatest known catastrophies of nature," said Kolata. Although fossils found in the ash indicate that many animals died, there appears to have been no massive planet-wide extinctions. Fossil species (tropical marine life) that appear in the layers immediately below the ash deposits occur in the layers above as well. "It took some of them a bit of time to migrate in and repopulate. But several feet above the ash, many of the same species recur," Kolata pointed out.

"These ash beds are useful to geologists," emphasized Kolata. "Because they were deposited rapidly—a flash in geologic time—they provide very precise widespread time lines. They are snapshots of geography at the time of deposition. They are also key marker beds that can aid in the exploration of oil and gas and other mineral resources."

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

Recycling Used Lubricating Oil

Enough used lubricating oil is disposed of improperly in the United States each year to equal ten to twenty Exxon Valdez oil spills.

More than one billion gallons of lubricating oil is sold annually and, while 750 million gallons is recycled or reused, much of the remainder ends up being improperly disposed of and contaminates our soil, surface water, and groundwater.

Used lubricating oil can be re-refined and used again as lubricating oil, or it can be used as a fuel. Collection of used oil for recycling or reuse has long been practiced at the industrial level and in automotive services. Because they generate large quantities, it is cost-effective for a collection firm to pick it up. For do-it-yourself mechanics and small shops this is not always true. As a result used oil is often thrown into the trash or into a sewer where it causes environmental problems.

To counter this problem, some recycling centers that collect glass, paper, and metals have also begun collecting used oil. In addition, two major oil companies, Amoco and Mobil, have initiated programs that allow do-it-yourselfers to drop off small quantities of used oil at designated service centers. Collection of used oil or reused oil can solve two problems. First, recycled or reused oil does not enter our groundwater or surface waters. Second, rigorous collection of used oil can conserve energy and reduce dependence on foreign energy sources.

For information on the management and safe disposal of used oil, as well as to receive lists of collection centers in your area, contact: HWRIC, One East Hazelwood Drive, Champaign, IL 61820 or call 217/333-8940.

THE FOUNDATION

New Board Members Named

Four new members have been elected to The Nature of Illinois Foundation Board in the past year.

Kenneth W. Gorden retired in 1989 after more than 40 years of farming— growing corn, soybeans, and certified seed. He still resides on Kenway Farm in Blue Mound, Illinois. Gorden received his B.S. in agriculture at the University of Illinois in 1947 and has been active through the years in service to agriculture, the University, and his community.

Kenneth W. Gorden

Ralph D. Grotelueschen

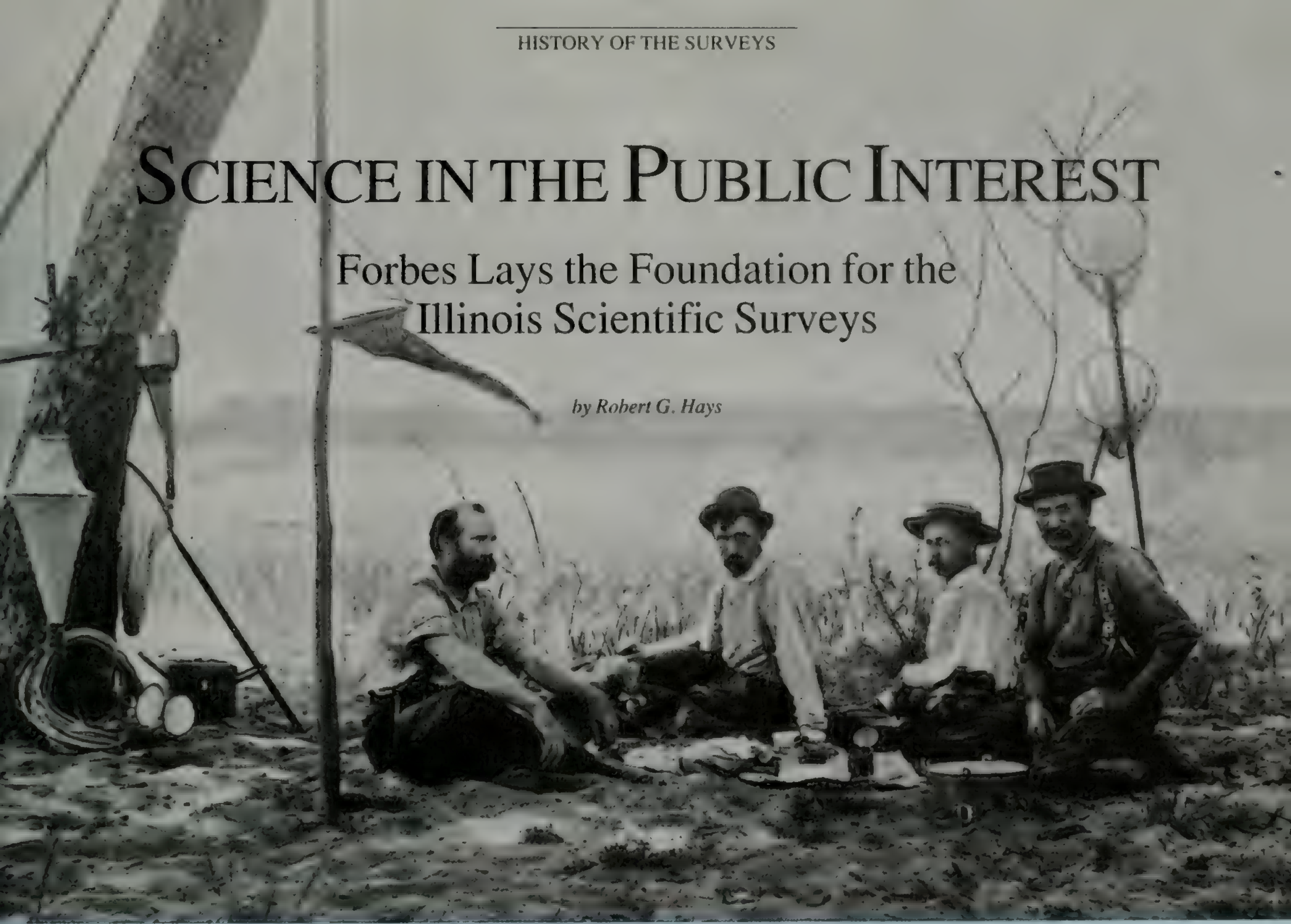
Ralph D. Grotelueschen joined Deere & Company in 1967 as a research plant biochemist and was appointed Director of Safety, Standards and Environment in 1984. From 1977 to 1978 he was part of the Presidential Executive Interchange Program where he worked for the U.S. Environmental Protection Agency as a policy analyst. During most of his career with Deere, Grotelueschen has been responsible for coordinating air, water, and solid waste pollution control efforts for all company factories worldwide. He holds a Ph.D. in agronomy from the University of Wisconsin.

Donald A. Wallgren

Donald A. Wallgren is Vice-President for Recycling, Development and Environment at Waste Management of North America, Inc. He is a civil engineering graduate of the University of Minnesota and holds a master's degree in business administration from Northern Illinois University. Prior to joining Waste Management, Mr. Wallgren held various positions with the U.S. Environmental Protection Agency and predecessor agencies. He also worked for Oscar Mayer & Co. and the U.S. Public Health Service.

Charles W. Wells is executive vice president and a member of the Board of Directors of Illinois Power Company. Except for two years service in the U.S. Navy, he has served Illinois Power in various sales and managerial capacities since 1956. He has been active in numerous church, civic, and professional organizations. Wells received a B.S. in electrical engineering and a master's degree in business administration from the University of Illinois.

Charles W. Wells



SCIENCE IN THE PUBLIC INTEREST

Forbes Lays the Foundation for the Illinois Scientific Surveys

by Robert G. Hays

Early Illinois naturalists on a specimen-collecting expedition

In the world of serious ecologists and environmentalists, the name Stephen A. Forbes commands respect that often borders on reverence. For it was Stephen A. Forbes, first chief of the Illinois Natural History Survey, who laid the foundation for the modern ecological movement more than a century ago with his research and writing on the interdependence of living organisms.

Stephen Alfred Forbes was one of America's most prominent scientists when he died in 1930. And justly so. For nearly sixty years he had been a mighty influence on the direction of the natural sciences in Illinois and—during much of that period—the nation.

A comprehensive account of his contributions to science could fill volumes. Forbes was a 28-year old teacher at Illinois State Normal University in 1872 when he accepted the post of curator of the Illinois State Natural History Museum. This appointment proved to be merely an early milestone in one of the most enduring and illustrious scientific careers in history.

To Study Nature Alive

The catalog of Forbes's scientific writing is a long one—his publications number in the hundreds. Yet a single short paper, "The Lake as a Microcosm," stands in many respects as his most important work, a true classic among early ecological studies. In this paper, first published in 1887, Forbes described a lake or pond as an isolated environment in which all organisms depend on each other.

Forbes saw rivers and lakes and streams as complex environments, teeming with life. He wanted biology students to get beyond the books and out of the laboratory, to study "nature alive." He wanted children to be drawn to the outdoors—"the woods and fields and waters"—and decried the loss of fellowship with nature. And while other scientists clearly recognized that human interference with natural systems might be harmful to those plants and animals directly affected, Forbes gave powerful voice to the view that resulting "oscillations of species" were injurious to humankind, as well.

A Young Man of Conviction

Forbes was a native of Illinois, born in 1844 into a pioneer family that had settled in the beautiful hill country of Stephenson County near Freeport, not far from the Wisconsin border. He knew hard times from childhood; when he was ten, his father died. An older brother, Henry, managed to support the family and keep Stephen in school.

Even as a youngster, Stephen held strong convictions—and had the courage to speak out on them. One sultry August afternoon in 1858 he took issue with the Honorable Stephen A. Douglas, who wa

Stephen A. Forbes as a young scientist during his years at Normal

in Freeport to debate Abraham Lincoln, his opponent in the U.S. Senate campaign. The matter on which young Stephen disagreed with the formidable "Little Giant," is not clear. In any case, his boldness brought reproof from the adults—though it seems likely the youth persisted in his own point of view.

Young Stephen Forbes thrived on mental challenge. He taught himself to read French, Spanish, and Italian. In 1860, at age 15, he enrolled in Beloit College in nearby Wisconsin. But within a few months the long-brewing Civil War erupted and changed the course of his life. He borrowed money to buy a horse, joined Company B of the Seventh Illinois Cavalry, and, in September 1861, rode off to war.

Armed conflict held little glory for him. He saw action in twenty-two military engagements and rode with Colonel Benjamin Henry Grierson's historic cavalry strike through the heart of Mississippi in the spring of 1863. He spent four months in Confederate prison camps and another three months in a Yankee hospital.

"But I always tried to keep myself human," he wrote of his war experience.

Characteristically, Forbes kept a daily journal of his wartime activities. He came to love the South, with its beautiful homes and elaborate gardens, its groves of "dark-leaved and snowy-blossomed magnolias," and, most of all, its delicate mimosa trees. Although he accepted as "stern necessity" the duty of the invading army, he wrote harshly of comrades who looted the homes and farms of innocent civilians. He took no pleasure in the destruction wrought on the South.

Even as a prisoner of war, the young cavalryman demonstrated the curiosity and determination that in later years would lead to his success as a scientist. Imprisoned in a dreary, malaria-ridden camp in Mobile, he persuaded his captors to let him go into town—accompanied by a shotgun-wielding guard—to buy books. He returned to camp with a Bible and a Greek grammar text. His subsequent study of the Greek language helped him maintain his morale; he noted later that keeping alive the flame of his intellect "through all the blasts and storms of war" was more valuable than the more mundane experience of going to college.

This probably was something of a rationalization. Despite his obvious academic potential, Forbes never had an opportunity to complete traditional college training. Indiana University granted him a Ph.D. degree in 1884, but it was awarded on the basis of "thesis and examination," not course work.

At the end of the war, Forbes returned to Illinois and entered medical school in Chicago. But he promptly encountered two serious difficulties: He did not have enough money, and the suffering of surgery patients—who lacked the benefit of modern anesthesiology—made medical practice unbearable for him. He turned to natural history instead.

The Right Career

It was clearly a fortuitous choice. Forbes's success as a scientist and teacher led to an early professorship and his appointment as museum curator at Normal. He developed a close association with some of the leading scientists in Illinois, including Cyrus Thomas of Southern Illinois Normal University, state entomologist and founder of the original Illinois Natural History Society. In 1882 when Thomas left Illinois to join the staff of the Smithsonian in Washington, Forbes was named to succeed him as state entomologist.

Early plant pathologist conducting experimental seed treatment

Interior of the early floating laboratory at the Havana station

(The museum at Normal, meanwhile, had become the State Laboratory of Natural History when the State Natural History Museum was established at Springfield in 1877. Forbes continued to head both the Office of State Entomologist and the Laboratory of Natural History until these agencies were merged into the present Illinois Natural History Survey in 1917 with Forbes as chief.)

Defining a Survey

Forbes had enthusiastically supported Thomas's earlier call for a survey of the state's plants and animals. It was, in his opinion, an "indispensable requisite" to the serious study of natural history. He had his own definition of a "survey," however. It involved a great deal more than a simple census of plants and animals and the publication of lists showing their distribution.

To Stephen Forbes, scientists had an obligation to broaden their studies to include the relationships between plants and animals and their environments; investigations of diverse living organisms were incomplete without parallel investigations of their habitats. He wanted to know not only the kinds of fishes that lived in the lakes and streams, for example, but also their food sources, their eating habits, and what other creatures shared their worlds.

Forbes's first Museum of Natural History *Bulletin* was published in 1876. It was a list of crustacea inhabiting Illinois waters. (The *Bulletin*, with appropriate institutional name changes along the way, is still published by the Illinois Natural History Survey.)

Forbes had continued to teach zoology at Normal—but that institution was going through difficult financial times. Trustees of Illinois Industrial University in Champaign-Urbana were watching developments closely, and in 1884 they invited Forbes to join their faculty. Assured that his scientific activities would be encouraged and supported, Forbes promptly accepted.

He made it clear that he expected to continue as state entomologist. This presented little problem. A larger question arose over the Laboratory of Natural History, established by statute at Normal. Since Forbes did not want to relinquish the directorship, he proposed that the laboratory be relocated to Champaign-Urbana. The Illinois General Assembly approved the move, and at the same time it granted a change in the name of the university: Illinois Industrial University became the University of Illinois.

From the beginning, the relationship between Stephen Forbes and his new university was one of mutual advantage. He brought to the institution his well-established reputation as a scientist and the considerable assets of the state entomologist's office and the Laboratory of Natural History. For its part, the university offered vital resources to support Forbes and his work. In 1888 he became the dean of the university's College of Science.

Forbes was among a small group of longtime faculty members who profoundly affected the course of the University during these early years. He was masterful in his ability to cross administrative lines and launch extensive research projects involving scientists from various departments of the university, the Agricultural Experiment Station, and his own agencies. This ability obviously was enhanced by the breadth of his own interests.

One early instance of such cooperative investigation was an exhaustive study of ways to control the cinch bug, which regularly caused extensive damage to Illinois crops. Stephen Forbes was among the first to appreciate the possibilities of introducing diseases into insect populations in order to control them; his work on cinch bug fungus was among the most significant early research in insect pathology.

Expanding the Horizons

The Chicago World's Fair in 1893 offered Forbes an opportunity to demonstrate to a much larger public the work of his agencies. Their exhibition, occupying 3,000 square feet of floor space, centered around an astonishing wildlife display—an exhibit of 775 mounted birds, most in natural surroundings. There also was a nearly complete collection of the fishes of Illinois, preserved in alcohol, and specimens of more than 7,000 insects. Such an exhibit, Forbes recognized, would help encourage public support. But more important, it illustrated his commitment to science in the public interest.

Orchard-spraying experiment circa 1900

Stephen Forbes had already proved himself to be a brilliant scientist and a powerful and resourceful administrator. He had been able to draw the threads of pure science together in ways others might never have imagined. Many of the investigations carried out by scientists in his agencies were of immediate practical and economic benefit, others more important for their general contribution to the knowledge of natural history.

Of all his varied personal interests, Forbes found aquatic biology most absorbing. In the spring of 1894 he opened a biological field station on the Illinois River near Havana, jointly sponsored by the Laboratory of Natural History and the university. This was an installation "unique in the country," he told university trustees, "and in some respects the only institution of its kind in the world."

The Havana station, with field work carried out from a floating laboratory, was the first inland aquatic biological station in the nation equipped for continuous investigation and the first in the world to undertake the serious study of the biology of a river system. Forbes said the station would have for its field the "entire system of life in the Illinois River and connected lakes and other adjacent waters." He expressed high hopes that it might carry out scientific research in a field up to then largely ignored, "not only in America but throughout the world."

A Remarkable Vision

Perhaps as much as any other undertaking, the Havana field station demonstrated Stephen Forbes's remarkable vision. But there is other evidence as well, for today his mark is almost everywhere on natural science in Illinois. Studies at the Havana station led to formation of the Illinois State Water Survey only months later, and, by the turn of the century, Forbes was at the forefront of an effort that eventually led to the establishment of the State Geological Survey.

In May of 1989, the Havana field station Forbes founded in 1894 was officially dedicated as the Stephen A. Forbes Biological Station. The ninety-five years between these events was a period of devoted and fruitful research by scientists using this facility. Unfortunately, it also was a time of virtually uninterrupted deterioration of the Illinois River because of human carelessness.

Forbes had the foresight to realize that the field station and its floating laboratory would allow "a comparison of present conditions with those of a former time." And, appropriately, much of today's work has greater significance because of the extensive database developed under the direction of Forbes and his successors.

Stephen A. Forbes devoted much of his life to the study of the Illinois River, which he saw as part of a larger system—complex and sensitive. Forbes compared a river system to a living organism, with periods of growth, development, transformation, and its own "personal behavior." And none of these, he noted, is independent from the larger, total environment.

He viewed a river system such as the Illinois as he would a vibrant giant. He observed that "the more completely one succeeds in unravelling the structure and analyzing the activities of this living leviathan, the more clearly he sees that it must be studied as a whole for an understanding of any of its parts, and studied in each of its parts for an adequate understanding of the whole." ■

Robert G. Hays teaches communications at the University of Illinois. His book, ***State Science in Illinois*** *(Southern Illinois University Press, 1980), traces the history of the Illinois Scientific Surveys and their forerunners from 1850 to 1978. This is the third in a series of articles on the history of the surveys.*

All photos courtesy of The Illinois Natural History Survey

DOWN TO EARTH

Story and Photography by Sheryl De Vore

A fossilized rock provides evidence of ancient marine animals buried by silt and sand.

From the bottom of a dolomite quarry on the east side of Oregon, Illinois, comes the rhythmic clang! clang! clang! of hammers pounding 400-million-year-old sedimentary rock. Dust clogs the eyes and dries the palate here, where once a vast inland sea flowed. Two men, one wearing blue goggles, simultaneously lift their hammers into the air and then heave them onto a rock which splits open to show the fossilized remains of a tiny, ancient sea creature. A woman looks up against the quarry face, more than 85 feet high, and is taken aback by the unyielding force of nature as young children run to field trip geologist, Dave Reinertsen asking, "What kind of rock is this?"

Follow the Leader

Here some 150 geology enthusiasts—grade school children, Boy Scouts, Girl Scouts, teenagers, elementary-school teachers, college professors, retirees, homemakers, campers, geologists, and doctors—are getting down to earth as they participate in one of four free annual field trips conducted by the Illinois State Geological Survey (ISGS). The trips began in the late 1920s as an educational tool for science teachers. Today these trips are open to the public.

A line of 50 or more cars follows Reinertsen, head of the ISGS Educational Extension unit and field trip leader for more than 25 years. The caravan winds through the Illinois countryside to discover what happened to the "Prairie State" thousands and millions of years ago and to pocket some fossils and other geological treasures. Picks, pails, and plastic bags in hand, the participants explore the Oregon area on this cool, partly sunny September day from early morning to nearly sun-down.

The area, located in Ogle County, 20 miles southwest of Rockford, is enjoyed for its subtle rolling hills and the scenic Rock River which cuts through low bluffs and wends its way past Lowden State Park. The landforms are the result of a succession of geological incidents—the forming of continental plates hundreds of millions of years ago, the forces deep within the Earth that created faults, and the retreat of glaciers 10,000 years ago. (Faulting is the fracture in the Earth's crust, accompanied by a displacement of one side of the fracture with respect to the other.) The oldest exposed rock material in Illinois occurs here, dating back more than half a billion years. There is evidence of how faults within the Earth's crust altered these rocks and of how glaciers changed the course of a mighty river. The remains of ancient creatures lay hidden here, embedded in rock for hundreds of millions of years.

"What I hope the participants will get out of these field trips," says Reinertsen, "is an appreciation for Illinois—the natural beauty of it—the relationship between the different rocks and the various soils that form from the rocks, the kinds of plants that grow in particular soils and on the rocks, and the types of native animals that depend on these varieties of plants."

Continental Collisions

The stage was set more than 600 million years ago during the Precambrian Era when Illinois (then located where Brazil is now) was part of a supercontinent in which all modern land masses lay together. From the beginning of Cambrian time, from about 570 million years ago up to about 245 million years ago, the supercontinent broke up, and warm, shallow seas inundated the interior regions of what is now our continent. "Shells of snails and clams and other marine animals were buried by silts and sands and gradually lithified into solid rocks of limestone and dolomite, shale, siltstone, and sandstone," says Reinertsen.

Some 480 million years ago, as the continental plates began to drift about, they collided, creating tremendous forces deep within the Earth's crust. What resulted were mountains, volcanoes, and faults, including the Sandwich Fault, which extends from northwest of Oregon to southeast of Joliet. These disturbances caused the bowing, tilting, and faulting of the rocks that had been layered neatly in the Earth's crust. Later, erosion helped to expose some of these ancient rocks, including the 480 million-year-old St. Peter Sandstone found here.

Young geologist prepares to free an ancient rock with his hammer.

"One of the top three or four fossil assemblages of the world is in Illinois."

Upon encountering the sandstone, several children immediately cup the soft, smooth, white and gray uniform grains in their hands. An eight-year-old Lincolnwood resident chisels away at the soft sandstone rock, known for its purity and ability to "disaggregate" into sandy grains after a mere rub. This rock, also found at Starved Rock and Buffalo Rock near Ottawa, Illinois, is mined for plate glass, window glass, and windshields, as well for use in the oil industry. "The St. Peter Sandstone is deeply buried farther south in the state and not accessible for commercial use," says Reinertsen. "But here, it was brought to the surface by the arching and faulting of bedrock and erosion."

Listening to the Rocks

A father proudly watches his son examine ancient rocks and comments that the ISGS excursions provide "education, fresh air, and exercise. If children are never exposed to these kinds of things, then as adults they'll end up in front of the television set," he says. Indeed, the youngster seems as enthralled with the St. Peter Sandstone as another child might be while playing Nintendo. "I like to learn about the

Amateur geologists look for evidence of fossils.

different rocks—the igneous, sedimentary, and metamorphic," recites the budding geologist, who has studied the science in school.

A visit to a nearby abandoned quarry gives all the geo-trippers a rare opportunity. Here, close to a fault, the St. Peter Sandstone is metamorphosed. Heat and pressure caused the rock to become quartzitic, making it hard and resistant to breakage. "When the sunlight hits it right, it looks like a handful of glistening sugar," describes Reinertsen, who responds to the beauty in each different rock.

Students from Highland Community College closely examine the metamorphosed St. Peter Sandstone and their instructor points out the brecciation that occurred due to faulting. "A brecciated rock is one consisting of sharp-cornered bits of fragmented rock, cemented together by sand or other particles," responds a student when asked for a definition.

At this site, faulting, bowing, and tilting have also exposed the oldest bedrock strata (Cambrian) in Illinois—500 million-year-old dolomite. Parts of the dolomite jut out from the ground, tempting those armed with hammers to try to free a piece to take home as a souvenir. Other parts of the dolomite are softball-size remnants that visitors can easily pick up to examine. "What you're holding is half-a-billion-years-old," says one man to a young boy, who looks at him quizzically, wondering just how old that is.

Heavy boulders, frozen within great sheets of ice, were carried from as far away as Canada.

"When you think about the age of these rocks you realize how insignificant you are on this Earth," says one participant who has taken the ISGS trips for 22 years. "In the scheme of geological timing, the existence of humans is but a second," he philosophizes.

Nearby, a mother gives her son a lesson in conservation. "Don't chip away so much of that rock," she lectures. "You want your great-grandchildren to be able to see it. Like an endangered animal, once it's gone, it's gone."

Human intervention, however, has exposed some rare evidence of faulting in the Oregon area. A railroad cut through some ancient rocks left behind examples of faulting at work. Standing on a bridge overlooking the tracks, participants can see horizontal layers of rocks interrupted by rock debris. "You can see the vertical displacement and the fault zones here," says Reinertsen. "We rarely see this sort of thing in Illinois. It was buried by glacial drift, then exposed because of the railroad cut."

Ice Age Sculpture

Glaciers had a heavy impact on the Oregon region. Beginning some 1.6 million years ago and ending about 10,000 years ago, massive tongues of ice flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky mountains. "Because Illinois lies entirely in the central lowland, it was invaded by glaciers from all of the North American centers of continental glaciation," points out Reinertsen.

Glaciers scraped and smeared the land over which they rode. Moving ice carried gigantic amounts of rock and earth materials for hundreds of miles, filling in ancient valleys and creating flatter land forms such as our Illinois prairies. Standing on an upland farm area near Oregon, Reinertsen and the group pause to imagine what the Earth was like when huge sheets of ice plowed through. "We are standing on 40 to 50 feet of glacial cover," says Reinertsen. "Glaciers smoothed the area creating gently undulating surfaces. When the valleys are filled with ground fog, the different surface elements are more easily recognized from this vantage point."

The serene beauty of an early fall day requires a moment of silence from the group. Participants then retreat for lunch at scenic Lowden State Park where an impressive 48-foot-high reinforced concrete statue of an American Indian stands on the bluffs overlooking the Rock River. Often called Black Hawk, in reference to the Indian chieftain who inhabited this area prior to white settlement, the statue attracts visitors from hundreds of miles away.

Field trip leader Dave Reinertsen inspects a "find" with a visitor.

The story of how the statue got there begins almost a century ago in 1898 when Chicago attorney, Wallace Heckman, purchased what is now the park area. A patron of the arts, Heckman founded an artist colony which became known as the Eagles' Nest for the majestic birds that nested in a cedar tree atop the high river bluffs.

One of the artists, sculptor Lorado Taft, often walked past the spot where the statue is now located and meditated on the Indians who once lived there. The Indians had fought hard against white settlers to keep their land, but eventually they failed, and Taft was inspired to create his memorial to the American Indian. The statue was dedicated on July 1, 1911.

Although the artist colony disbanded in 1942, the statue stands as a reminder of those idyllic days. The Illinois Legislature appropriated funds in 1943 for a memorial to former State Governor Lowden and the area, including the place where the statue stands, became Lowden State Park. Sixty-six additional acres were given to Northern Illinois University to be used for an outdoor teacher education program.

Here visitors can walk down narrow winding steps in the woods to the river and pause at intervals to gaze at the statue, perhaps contemplating the look in the statue's eye and think about what the area meant to the Native Americans. Visitors might imagine Chief Black Hawk surveying his land sadly after he lost it in a hard-fought war. "Rock River was a beautiful country," he is reported to have said. "I fought for it. It is now yours. Keep it, as we did."

But the area did not always look as it did when Chief Black Hawk enjoyed it, reminds Reinertsen. The Rock River wends through Oregon only because of the glaciers. The pre-glacial Rock River was located some 18 miles east of Oregon, but glacial forces caused it to change course. "As a result, the river has been a great waterway for generating energy for the communities along the bank," explains Reinertsen. Observers can appreciate the great force glaciers must have exerted to change the course of this moving body of water, which was powerful in its own right, as evidenced by the bluffs it carved.

A visit to a nearby gravel pit provides further evidence of a glacier's mighty force. Rocks such as granite were carried to this quarry from as far away as Canada. Here visitors can examine heavy boulders that were frozen within the great sheets of ice and displaced to this new location.

A Rich Fossil Record

Glaciers may have greatly disturbed the Earth and uprooted heavy material, but embedded deep within dolomite in the Oregon region is evidence of the tenaciousness of nature. Fossils!

About 600 million years ago, Illinois was part of a supercontinent and it was located where Brazil is now.

"To think how extremely old fossils must be—that they were once living creatures is amazing," exclaims an 87-year-old Kewanee resident who has been going on the ISGS field trips almost since they began. He recalls the thrill of finding seemingly ordinary rocks and cracking them open to expose fossils. "I'll never forget one day when I found a rock, gave it a good blow with my hammer, slid it open, and saw the fossilized remains of a butterfly. It was wonderful."

Lorado Taft's 48-foot-high statue of an American Indian, popularly known as "Black Hawk," stands on the bluffs at Lowden State Park.

Dr. Merril Foster, a geology professor at Bradley University in Peoria, says he has found some of the best fossils on ISGS trips. "The ISGS has shown me locations I didn't know about," he says. On a recent trip he discovered blastoid fossils, extinct cousins of the starfish. "Illinois has one of the best blastoid populations in the world," adds Foster, who collected the artifacts and then brought students back to the spot to examine and measure species and discuss their variations.

"People should know that one of the top three or four fossil assemblages of the world is in Illinois," points out Foster, "and that the ISGS is one of the best programs of its kind in the country. These field trips open your eyes to the beauty and wonder of Illinois. You not only learn about rocks, but about botany and history, geography and ornithology."

"Today I learned about the artist colony. On an earlier trip I learned that Shawneetown in southern Illinois was once the metropolis of Illinois and much bigger than Chicago. I've discovered killdeer nests on trips and unusual insects such as horsehair worms."

At the final stop—a former working quarry loaded with 400-million-year-old fossil-embedded dolomite—one of Foster's students discovered her first fossilized rock. "This is really a good find," Foster says to the delighted students as they examine cephalopods (a class of mollusks with a distinct head and muscular tentacles about the mouth) and trilobites (a class of extinct marine organism with bodies divided into three parts).

Meanwhile, ISGS geologist Jim Jennings is bombarded with questions about the clams, snails, and other lithified organisms trapped in the rocks. Field trip participants stuff bags and pails with fossilized rocks and load them into their cars.

A light drizzle begins to fall and night edges in. One by one the amateur geologists pick up their hammers, hardhats, buckets, and field guides and head out of the quarry toward home. In a couple of hundred years—the blink of an eye, geologically speaking—these Illinoisans will be long gone. But tiny sea creatures embedded in prehistoric rock will still be here, telling stories of the ancient Earth. ■

Oregon, in northern Illinois, is in a scenic area about 20 miles southwest of Rockford. Castle Rock State Park and White Pines Forest State Park are nearby, as is the John Deere historic site. For more information on places to stay and things to do and see in Ogle County, call the Illinois Department of Conservation (217) 782 7454 or the Ogle County Bureau of Tourism (815) 732 7286.

Sheryl De Vore is a nature and environment columnist and staff writer for Pioneer Press Newspapers in Bannockburn. A regular contributor to a number of nature-related publications, she is a volunteer docent and bird walk leader for the Ryerson Conservation Area in Deerfield

THE ART OF RECYCLING

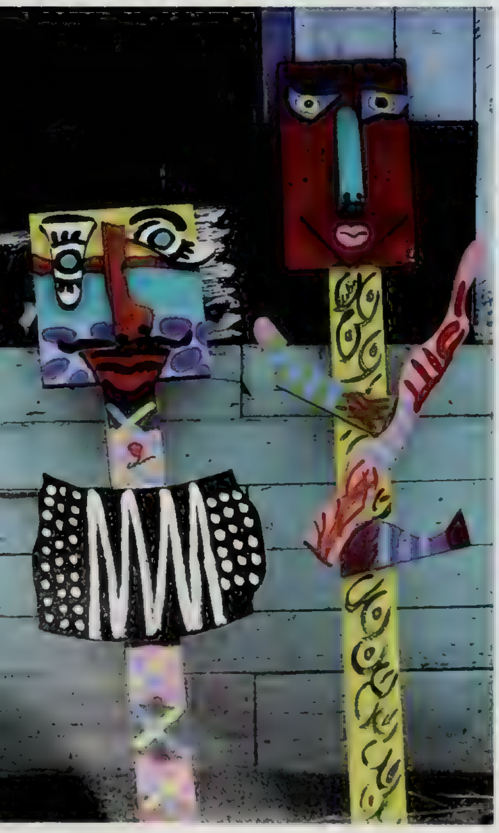
by Tara McClellan

George Colin's workshop is a kaleidoscopic jungle. Fuchsias, yellows, and shades of turquoise blind you while eight-foot-long spotted alligators, zigzagged purple snakes, and Abraham Lincoln butlers prey upon you.

Colin is an artist who lives in the tiny town of Salisbury, near Springfield. His work, often described as folk art, is in every state of the nation, in Europe, and in Jamaica. It adorns President George Bush's Kennebunkport home and Illinois' Executive Mansion. A nearly two-year-old Chicago gallery called "Georgeart" sells his work almost exclusively—and does so at a reported average of 25 paintings per week.

This success is a unique turn in the life of a man who labored in a flour mill for 30 years and painted in his spare time. Colin's only formal art education was a correspondence course in commercial art almost 40 years ago. But about 1980 his life changed.

George Colin in his Salisbury workshop with his dog



A bright welcome to [illegible]'s workshop

"After 30 years at Pillsbury, he had a lot of illnesses. He hurt his back...he'd had a slight stroke and a minor heart attack. So he started painting full time. He turned his back on the real world and crawled into his art. And he's still there," says his wife, Winnie.

She and Colin scoured sources for "found materials" Colin could use in his art. "We dug bottles out of the dump and went in everybody's trash pile. We got all the wood for free and recycled it. We'd come home, take out all the nails and save them. We'd buy some paint and make something beautiful that everybody seems to want."

All of Colin's diverse wood art is made of scrap lumber—discarded wood palettes, or old barn wood. "We kind of recycle it," says Bill Glass, Colin's stepson and assistant. "I think that's a whole lot better than building a big fire and burning it up."

Colin used to work with a printing company's discarded paper for his "flat art," paintings and drawings in acrylics, pastels, and mixed media. Now his flat art, which includes rural scenes as well as bright, almost Caribbean-like settings, is on new, acid-free paper for better preservation.

Colin estimates that three-fourths of his art is made of recycled materials: "I would have to say I can't think of anything we haven't painted, from metal sculptures to wood plows." A quick survey of Colin's workshop provides evidence. The sixty-one-year-old Colin works in a new barn, strewn with straw and heated by a turn-of-the-century potbelly stove. His work hangs from the ceiling and walls, and consumes every inch of available floor space not already occupied by the family cats and dog. Among his lively, often whimsical and vividly colored works, are a painted purse, luggage, guitar, skillet, milk cans, and ammunition box. In his adjacent home are painted milk, soda, and Aunt Jemima syrup bottles.

Colin gets used furniture from the Salvation Army, Goodwill, or friends, and by painting them with bright watermelons, fanning peacocks, or other colorful designs, turns them into functional works of art. While the Colins originally recycled because they couldn't afford new art materials, they now recycle by choice.

Color is Colin's main art signature. There are no pale hues here, only vivid, vibrant shades. "I did some reading on Gauguin, and he wrote that a person ought to use pure, bright colors. I thought that was a great idea...everybody's affected by color. Every artist has his own way of presenting beauty, but I think color is one of the most positive ways," he says.

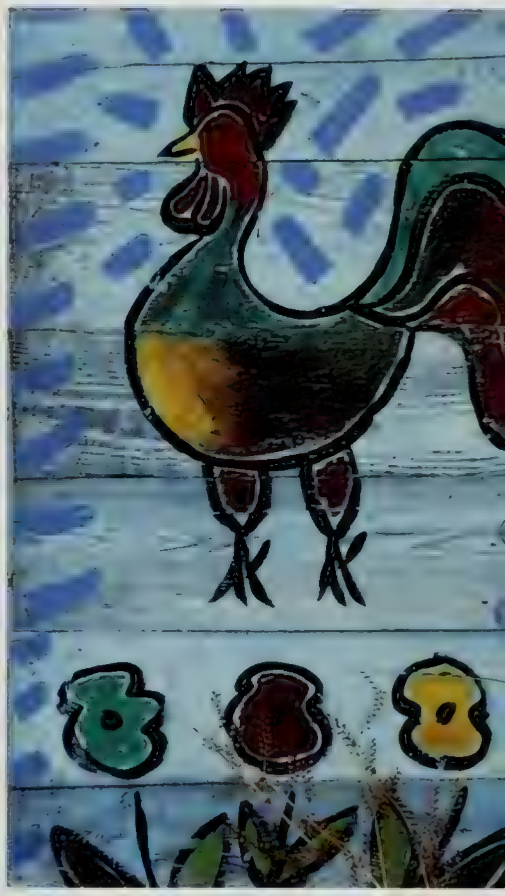
Colin describes his work as "post-naive." He hopes it "takes people back into a world that's more primitive and pure, the world that we're losing, the jungle world. I'd like to try to take people back to the days of Adam and Eve."

Colin began making his wood art several years ago. He painted benches or made standing figures and placed pieces in his yard, which sits along a well-traveled rural highway. Many tourists stopped on their way to New Salem, a favorite Lincoln site, and Colin began selling some of his work, which became popular largely through word-of-mouth.

In 1989 Glen Joffe, who owned some Colin pieces, approached him about holding a one-day show of his work at a Chicago art gallery. Approximately $20,000 worth of Colin's art sold and the gallery expanded a year later to include other artists' work. In April of last year the gallery moved to a larger facility.

Now Colin works sixty or more hours a week, resting "just long enough to eat" according to Winnie. He completes two to ten pieces a day. "He'll do wood, then pastel, then wood, then maybe acrylic," Glass says.

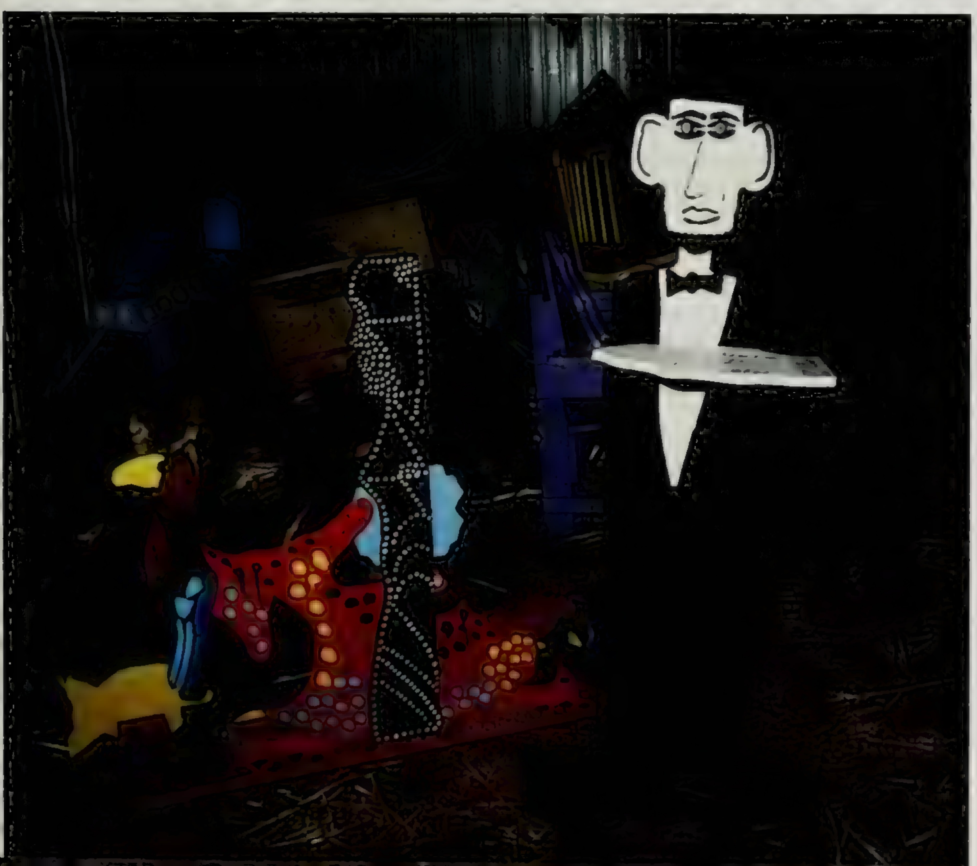
When Glass returned from California a couple of years ago to help Colin full time, one of his first jobs was to inventory the work Colin had amassed in a neighboring century-old house. Glass says he found thousands of pieces stacked in piles which reached to the ceiling.



Back to a world more primitive and pure

"I think that this is just a basic need in me—to express myself this way," Colin says. "I feel lost if I don't do this. I feel like I'm not giving. This is my way of giving I guess." ■

*Tara McClellan, a regular contributor to **The Nature of Illinois**, is a free-lance journalist and arts reporter for Public Radio in Springfield.*



"I would have to say I can't think of anything we haven't painted."

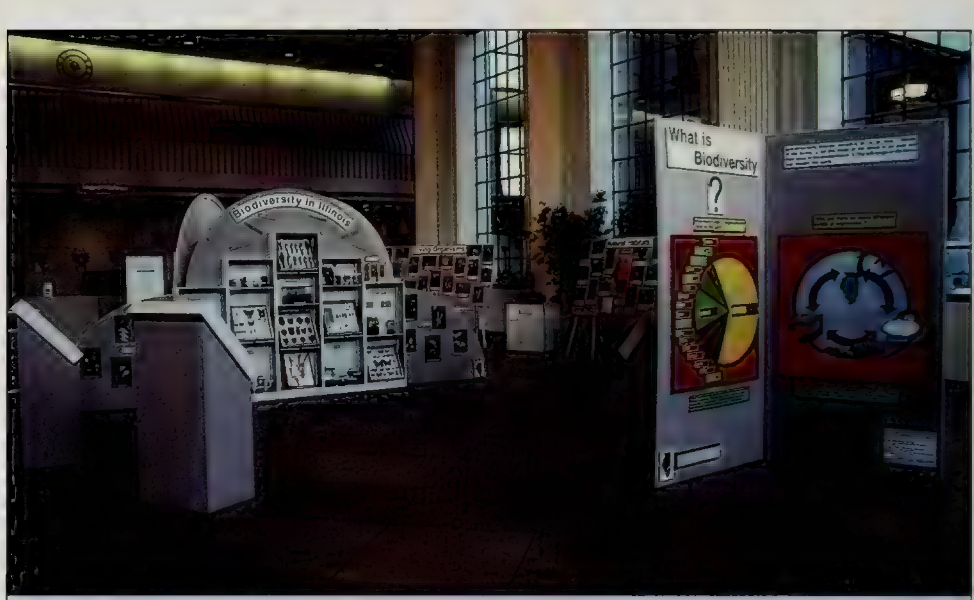
(continued from p. 4)

new species into our floral and faunal community, they are no less useful for writing obituaries of forms that have disappeared. With the exception of the showiest birds, mammals, and flowering plants, however, biologists are reluctant to say with finality that a species is extinct. The possibility always exists that a few individuals or a small population will be discovered in some remote habitat.

The vast majority of species worldwide are unmonitored. Like the dead in Gray's *Elegy Written in a Country Churchyard*, they may pass from the Earth unnoticed and unknown. ■

Susan L. Post is an Assistant Research Biologist at the Center for Biodiversity of the Illinois Natural History Survey. A complete table of Illinois species numbers, including species that have been extirpated, is available in ***Natural History Survey Bulletin 34, Article 4, Symposium Proceedings: Our Living Heritage****.*

The bird's-foot violet is one of the first species to bloom each spring on the glacial terraces of northern Illinois. It is most common in dry or sandy prairies.



Biodiversity in Illinois

Biodiversity on the Road

The rich natural heritage of Illinois is the subject of an elaborate traveling exhibit, *Biodiversity in Illinois*, developed by the Illinois Scientific Surveys with the support of The Nature of Illinois Foundation.

Photos, maps, narratives, and specimens explore the delicate balance that exists between the forces of nature and all living things. Included are explanations of how the geology of Illinois contributed to an abundant variety of plants and animals and how climate interacted with landforms to create distinct habitats that support such diverse species as prickly pear cactus and native pine, snapping turtles and wild turkeys.

Since *Biodiversity* began its trek around the state at the Chicago Botanic Garden in January, a new electronic question-and-answer panel has been added. In addition, a set of books (described below) is now traveling with the display so parents, teachers, and children can sample some of the best of what's available in children's science and nature literature.

At many locations along the way, visiting scientists from the Illinois Scientific Surveys and Hazardous Waste Research and Information Center are giving lectures to complement the exhibit. If you would like an itinerary of places *Biodiversity* will visit in the future, or would like to enquire about having the exhibit visit your community, contact The Nature of Illinois Foundation (312) 201 0650.

The Newest and Best in Nature Books for Children

NatureConnections, a project of the Chicago Public Library, has compiled a list of 17 notable nature books. Selections are suitable for children from preschool to grade nine and include such provocative titles as *And Then There Was One: Mysteries of Extinction* and *Never Kiss An Alligator*. We owe it to our children to provide them with books like these–beautiful, well-written, and scientifically sound. For an annotated book list, send a self-addressed stamped envelope to Books, The Nature of Illinois Foundation, 208 S. LaSalle St., Suite 1666, Chicago, IL 60604.

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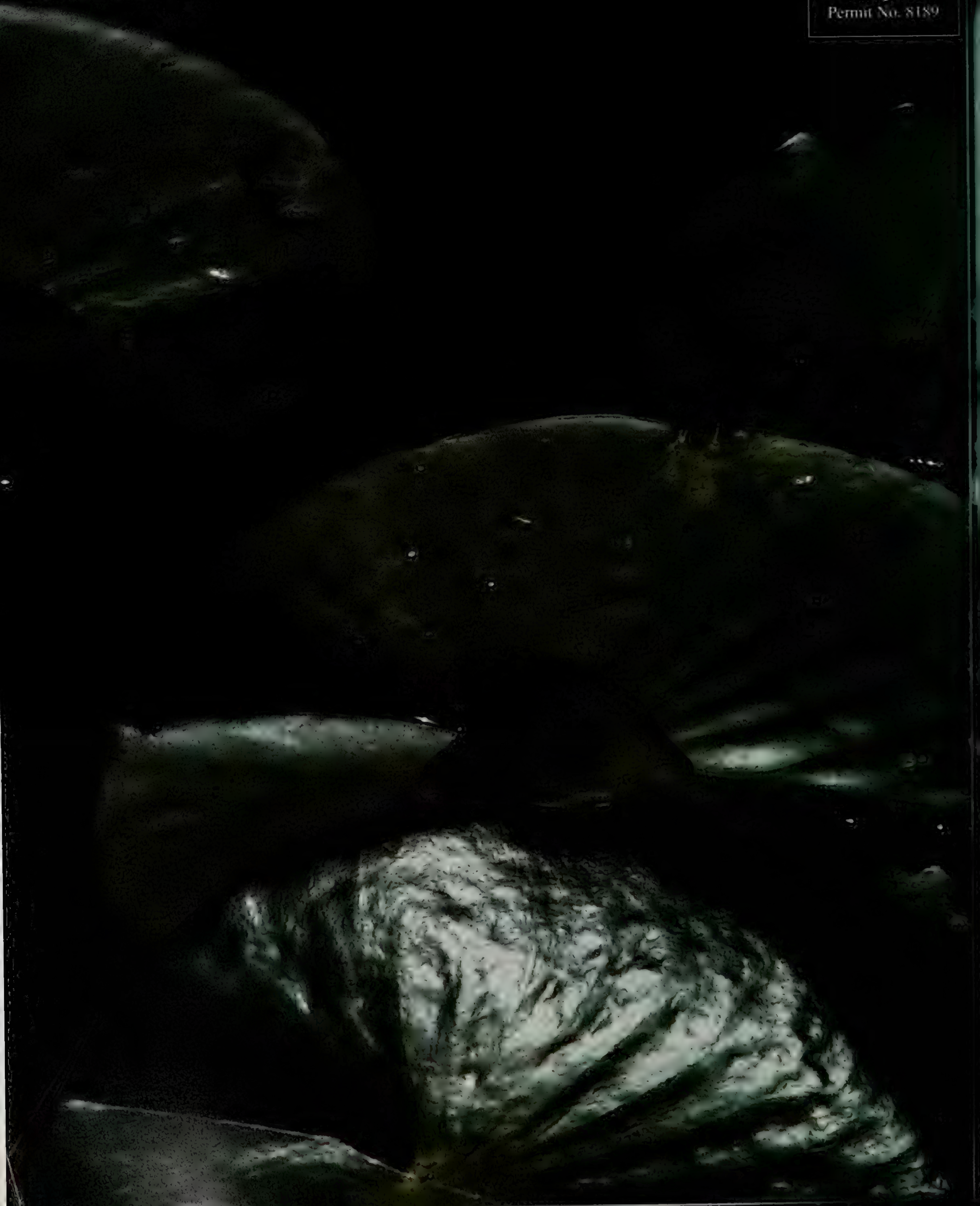

THE NATURE OF ILLINOIS

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THE NATURE OF ILLINOIS

Fall 1991 - Southern Exposure

From the Foundation

Scientists tell us that most of the species of plants and animals on earth are unmonitored and that only about two percent of them have been cataloged. We don't know what is tucked away in various habitats, we don't know which of them are threatened or endangered, and we don't know what role these unknown species might play in the health of our ecosystem.

If we concentrate on restoring and preserving not just bits and pieces, but whole ecosystems, the plants and animals—known and unknown—will have a chance at survival as well.

Beautiful, diverse southern Illinois, the focus of this issue of ***The Nature of Illinois***, is an area where caring individuals and federal, state, and private agencies are working together to beat the clock and even—where possible—turn back the clock to save a precious, diverse natural area.

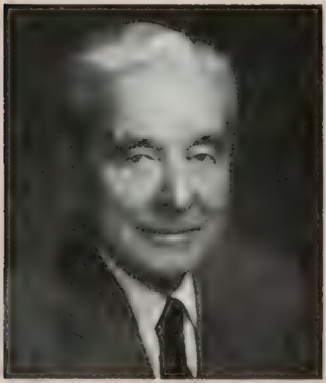
We are proud of the role the Illinois Scientific Surveys and the Hazardous Waste Research and Information Center play in projects such as this—to gather the data, conduct the necessary research, and make many of the recommendations that can lead to wise conservation decisions.

I hope you enjoy reading about beautiful southern Illinois and that perhaps you can plan a trip this fall to see some of the unusual natural areas described in this issue of ***The Nature of Illinois***. And I hope you will join me and the Foundation in supporting the work of the Surveys and Hazardous Waste Center. You will find a membership form in the pages of the magazine.

Warmest regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors



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About the Cover

The green frogs lives near the edges of swamps, ponds, or lakes and can often be found among the rotting debris of fallen vegetation.

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AN URGENT PLEA TO OUR READERS!

Many of you may have been receiving complimentary copies of *The Nature of Illinois* and many others of you may be preparing to read this copy in a library, an office, or the home of a friend.

As you enjoy this issue's articles and beautiful photographs, please know that the rising costs of publishing and mailing a magazine of this caliber brings The Nature of Illinois Foundation face-to-face with some unpleasant choices. Our budget tells us we may have to reduce the total number of pages in each issue, reduce the number of color pages, or reduce the number of issues we publish each year. Or it may mean we can no longer send complimentary copies to the public and private schools in Illinois.

None of these are happy choices, and so we are appealing to those of you who have enjoyed *The Nature of Illinois* to help by promptly renewing your subscription if it has expired. Or, if you do not already have a subscription, we encourage you to take one out today. Please consider taking out a membership/ subscription at the highest level that is comfortable for your own budget. You will find membership forms in the center section of the magazine.

And to those subscribers who have been strong supporters in the past, I would ask that you consider a special donation to The Foundation to help us continue to keep citizens of Illinois informed through this magazine and through our special educational projects.

John D. Schmitt, Executive Director
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CACHE–A RISING STAR

by Jean Gray

> *"I read that Daniel Boone came over from Kentucky a few times but never did like it here. He didn't like swamps and he didn't like mosquitoes. In his opinion, the land around the Cache River was just worthless."*
>
> Max Hutchison, Cache River Ecologist for the Nature Conservancy, whose family has lived in the Cache River Basin for three generations

Boone would have been puzzled by the enthusiastic crowds that came together May 18, 1991, to dedicate a joint venture to save "worthless" old Cache and her surrounding swampy wetlands, hill prairies, and bottomland forests—a project they hope will some day conserve and restore 60,000 acres in this unusual valley tucked away in the narrow southern tip of Illinois between the Ohio and Mississippi rivers. Clearly, public opinion about the Cache had swung full circle since Boone's assessment of it.

The Governor of Illinois and federal and state legislators attended the dedication at Shawnee Community College that day, as did the Citizen's Committee to Save the Cache River and the four Joint Venture partners that spearheaded the project: The Nature Conservancy (TNC), the Illinois Department of Conservation (DOC), U.S. Fish and Wildlife Service, and Ducks Unlimited (DU).

The movers and shakers came from the U.S. Department of the Interior, U.S. Army Corps of Engineers, and Illinois Nature Preserves Commission. There were local bankers and farmers, Boy and Girl Scouts, the media, volunteers, hunters, fishermen, birders, geologists, botanists, biologists, ecologists, teachers, and students. Many of them had worked diligently for this day, some for as long as 25 years.

Noted for its ability to withstand flooding, the buttonbush is a common inhabitant of Cache River bottomlands. Its fruits are eaten by wildlife, and are particularly appealing to mallards.

What's the Cache?

What was it about the Cache that captured the attention and imagination of such a diverse group?

It might have been the recognition that this was one of the largest, most valuable remaining wetlands in Illinois—an area essential for flood control, ecosystem purification, and wildlife habitat. Or it might have been something that touched their spirits.

Start with the Upper Cache, a natural time machine where one can journey back two hundred years—and more—to presettlement Illinois. There Little Black Slough and Heron Pond make up a mood-piece of primeval tupelo and cypress swamp, a fine example of true southern swamp at its northernmost range. Great blue herons, green herons, and the rare yellow-crowned night heron are regularly found here. The pileated woodpecker, black vulture, turkey vulture, and rare Swainson's warbler are here, too. An important stop for Mississippi Flyway waterfowl, this is the breeding ground for brightly plumed hooded mergansers and wood ducks.

Atop nearby Wildcat Bluff coneflowers spill down well-drained, thin soiled limestone outcrops amidst little bluestem, big bluestem, side-oats grama, prairie dock, and Indian grass. Remnants of hill prairies like this one—once several square miles in size—still offer impressive views of floodplain forests and upland woods from lofty positions on south-facing bluffs.

Just off the blacktop on a road near Belknap, there is a small treasure that was cypress and tupelo until it was drained and cleared for grazing just a few years ago. Fed by a clear spring, this was a favorite stopping place for travelers in covered wagon days. Here, despite recent disturbances to their habitat, rare copper irises bloom—a whole colony, in shades that vary from lemon yellow to dark rusty copper. "You see the copper iris on the edges of swamps down in Louisiana," says Max Hutchison, "but you don't often see them this far north."

Limekiln Springs Trail on the Lower Cache, newly developed by The Nature Conservancy, leads through stands of overcup oak, pin oak, kingnut hickory, tulip tree, sugar maple, sugar berry, red maple, sweetgum, mulberry, and black walnut. New wooden walkways lead over a sometimes-flooded forest floor to a spring-fed slough with stands of cypress and tupelo. Dave Maginel, TNC's Lower Cache River Land Steward, reports that the flooded forest in spring and fall has a living carpet of honking, quacking waterfowl.

Buttonland Swamp, where the state champion cypress grows, is a perfect place to see tupelos and marvel at thousand-year-old bell-bottomed bald cypress trees surrounded by orange-tipped "knees," some as high as ten feet tall. Cottonmouth snakes swim dark lines through bright green duckweed-covered-swamps here, and prothonotary warblers flit among buttonbush branches and Virginia creeper vines. River otters and mink can sometimes be spotted swimming by and even the federally-endangered bald eagle, absent for so many years, now makes an occasional appearance.

How the Cache Was Lost

These magic places are some of what remains of the rich watershed of the Upper Cache River that flows west to east out of the Shawnee Hills, and of the Lower Cache River that heads back westward through the wide flat valley carved out—and then abandoned—by the ancient Ohio River.

During the past 90 years alone, 230,000 acres—more than half—of the former wetlands have been drastically disturbed and changed. The story of what has happened to the Cache since the mid-1700s mirrors the world-wide struggle of man to control, tame, and exploit the land.

The red-shouldered hawk, one of Illinois' endangered species, finds refuge in the moist, diverse woodlands of the Cache River wetlands.

At first the lowlands were spared because early settlers, deterred by the gloomy swamps and huge trees, settled in the more open country and upland wooded areas along the rivers. Market hunters, trappers, and commercial fishermen, on the other hand, saw opportunity in the abundant wildlife harbored by the wetlands, and loggers soon discovered the river basin with its cypress and tupelo and rich bottomland forests. After the Civil War, more and more land was swallowed up by timber interests—the Cache had some of the finest timber in the world—and sawmills sprang up at Karnak, Belknap, Ullin, and Rago. The sawmills did well but, in many cases, once the virgin timber was downed, the cutover swampland was considered useless. Although reforestation was an idea whose time had not yet come, there were some examples of responsible timberland stewardship—notably, the Main Brothers, who owned the largest mill and were selective in their logging practices. Hutchison points out that "It was not logging that was responsible for the decimation of the Cache, it was the drainage."

Ditches, originally carved out of the earth to float logs to the sawmills, foreshadowed the serious ditching, dredging, and channeling that would ultimately split the Cache in two and turn acre after acre of swamp and bottomland into farm fields.

After World War II, large-scale land clearing accelerated, and by the 1960s and '70s a frenzy of speculation saw land change hands so fast that nobody locally knew who owned it any more. Some of the land was gobbled up by out-of-state buyers who had never laid eyes on what they had purchased.

(The land, however, registered intermittent protests; while many upland farms did well—except where the soil was thin and droughty—the bottomlands and swamps refilled with flood waters often enough to create hardships, ruin crops, and lead to more-than-occasional bankruptcies.)

(opposite) Snowy egrets are occasional visitors to the wetlands along the Cache where they feed in the shallow water on frogs, snakes, and crayfish.

Clashes arose between timber interests, farming interests, and fishermen and hunters—sport hunters now, not market hunters. The Cache River Drainage Commission, which had been formed in 1911 to "improve" the land, was viewed as demon or darling, depending on which group you asked.

Whose Wetland is it Anyway?

Coffee-shop talk in the '60s often focused on how agricultural interests were infringing farther and farther into wetter and wetter areas. There was strong feeling that some of the land being cleared was absolutely not productive for agriculture. Many of the local people had grown up hunting and fishing; they loved the Cache, and they could see good wetlands being traded for farmland that was marginal at best, and in many cases just plain poor. "But these drainage people seemed to have uncontrollable powers," commented Anice Corzine, a Cache booster who saw his family's land being ruined and, like the others, was frustrated by what seemed like a battle that could not be won.

It was the love for duck hunting that brought Neal Needham into wetlands conservation. Needham, a lifelong resident of the Cache and now a bank president, knew how to mobilize the concerned local people and, even more important, how to engage forces from outside the community. His first call for advice went out to Frank Bellrose, the Illinois Natural History Survey's authority on waterfowl and habitat management. (See "Dean of the Ducks," page 24.) Another important call was to Corzine, and on June 10, 1979, The Citizens Committee to Save the Cache River was incorporated, and one piece of the coalition to save the Cache was in place.

The turning point came in January 1980, when TNC heard about the campaign on the Lower Cache and invited Needham to bring his slides of this impressive wetland to Chicago. Soon after, TNC bought its first piece of land on the Lower Cache.

Heron Pond is a prime example of true southern swamp at its northernmost range.

Another important player in elevating the Cache beyond a local issue was Henry Barkhausen. Marvin Hubbell, DOC wetlands program administrator, says, "It was Barkhausen's tenacity that kept things moving and boosted the Cache project to the next level. Barkhausen is a hunter, conservationist, and businessman who knows the Cache and loves it well." As Director of the DOC under Governor Ogilvie, Barkhausen saw the birth of the precursor of the DOC's Natural Heritage Division and the beginning of strong state initiatives for preserving the natural resources of Illinois.

The Cache was not unknown to ecologists and naturalists. The unique value of the area's habitat, plants, and wildlife had been noted as early as 1963 in an Illinois Natural History Survey publication by botanist Robert A. Evers. The work of botanists and biologists at Southern Illinois University continued to raise the consciousness of ecologists and conservationists in Illinois about the precious natural heritage of the Cache.

Throughout the '70s, during the ten years prior to the blossoming of the campaign to save the Lower Cache, the DOC and TNC were already putting together valuable pieces along the Upper Cache—Wildcat Bluff, Heron Pond, and Little Black Slough. On through the '80s, they continued to add to their holdings along both the Upper and Lower Cache; however, 200 years of unwise decisions had destroyed the integrity of the area's hydrological system, and nobody had a clear idea of how to heal the wounds that had been inflicted.

When the DOC called in the Illinois State Water Survey (ISWS) in 1982, it was the first time scientific data collection and monitoring would be available to provide the basis for informed management of the hydrology of the Cache River System. (See "Currents," page 10.)

"The importance of sound science in making wise conservation decisions cannot be overestimated, particularly in the Cache where everything depends on water," says TNC's Assistant Director Paul Dye. "If you can protect the hydrological system of a wetland, you're on your way."

How the Cache Will be Won

In 1986 Congress enacted the Emergency Wetlands Resources Act, setting the stage for the U.S. Fish and Wildlife Service to join the DOC, TNC, and Citizens Committee in their coordinated effort on behalf of not just pieces of wilderness but entire wetlands ecosystems.

On June 26, 1990, the Service established the Cypress Creek National Wildlife Refuge with a purchase boundary of 35,200 acres along the Cache River and a major tributary, Cypress Creek. ("Purchase boundary" identifies those lands the Service is empowered to buy from willing sellers.) The refuge will be managed and protected for the benefit of plants and wildlife, and Jerry Updike, refuge manager for the Service, plans to open the area to the public for interpretation, education, and outdoor recreation.

The DOC Lower Cache River Natural Area now has some of the finest remaining bottomland forests in Illinois.

Their recent acquisition of an important tract of Main Brothers land brings the acreage under its stewardship in both the Upper and Lower Cache to 9,000 and, for the first time, DOC is maintaining on-site staff in the Cache.

TNC is establishing the 20,000-acre Lower Cache preserve in the Limekiln Slough area and continues to assist the Service and DU in land acquisition. DU acquired 1,000 acres east of Interstate 57 in 1987 and is developing a waterfowl-management area. Hardwood reforestation began in 1989 with TNC volunteers collecting acorns for direct seeding on former cropland, using methods pioneered and proven by the U.S. Forest Service and wildlife agencies in Mississippi and Louisiana. (Hutchison has recently sighted wildlife species that have been absent from the Cache for years; and Updike states that his top three priorities are: habitat! habitat! habitat! "If you bring back the habitat, the critters will return," he says.)

TNC and DU are already building the next addition to the project—the Frank Bellrose Waterfowl Reserve—which should be ready for dedication next year. It will include 2,100 acres within the Cypress Creek National Wildlife Refuge to be restored, developed, and managed for wood duck nesting and for migrating waterfowl.

Understanding Wetlands

"Take a tabletop—the table represents bedrock. Put soil on it, pour on water, and the soil just washes off the table. Now put some soil on a table and lay a thin sponge on top. Drive some nails down through the sponge—the nails represent trees and the sponge represents the layer of vegetation and leaf litter. Then when you pour on water, it is absorbed by the sponge and, because it is released slowly, the soil stays on the table. What this means in the real world is that the soil stays in the wetlands and the water is filtered and released slowly into the aquifers, plants, nearby waterways, and the atmosphere, saving rivers and streambanks from erosion and from damaging overloads of siltation."

Jerry Updike, Refuge Manager U.S. Fish and Wildlife Service

Colonies of copper irises bloom in a spring-fed field near Belknap. The copper iris, often seen on the edges of Louisiana swamps, is rare in Illinois

"A project of this size has got to be economically viable," says Dye. "If we can't find a way to repair the natural system down here and simultaneously improve economic opportunities, we will have failed. Land resource decisions have to be driven by economic realities."

The U.S. Soil Conservation Service and County Soil and Water Conservation Districts are encouraging landowners to plant poor cropland with permanent cover or convert it back to timber; landowners with good cropland are being advised about sound agricultural practices that not only will be economically advantageous but also will protect the wetlands.

Dye sees good prospects for future sustainable timber harvest in the Cache and a shift in the economic base to tourism, that will serve hunters and fishermen, birders, hikers, canoeists, and campers.

There are opportunities for scientific research and education as well. John Yopp, dean of the graduate school of Southern Illinois University, and his faculty are exploring the formation of a consortium with the other active players in the Cache. "I see great opportunities for unique wetlands research and also opportunities to study the interface between agriculture and wetlands," says Yopp.

The Last Great Places

This spring, as excitement was growing on the Cache project, TNC announced a bold new initiative: "Last Great Places," working models for large scale ecosystem conservation in the Western Hemisphere. Twelve sites have been selected in conjunction with more than 100 public- and private-sector partners to demonstrate that the protection of functioning ecosystems for the preservation of species diversity can accommodate human economic and cultural needs. Dye believes the Cache is a prime candidate for "Last Great Places" status because of its value as a wetland system, its importance as a stopover for migratory birds, and also because it has a valuable core natural area that needs a protective buffer zone.

"By reason of the fate of this location," says Dye, "we can capture an incredible amount of biological diversity and protect a wide range of biological resources. What has been happening on the Cache mirrors the challenge we face around the world to strike a new balance between economic needs and ecological conservation."

It is no small challenge. ■

Most bryozoans are marine; fewer than 50 of the 3,500 species live in fresh water. Their waving tentacles create currents that pull in algae, protozoans, and decayed matter.

PLANKTON: LIFE'S INVISIBLE LINK

by Sheryl De Vore

A green-backed heron stands motionless, poised over a shallow marsh, its eyes intently watching the water, waiting. A perch swims by. Snatch. The heron grabs the fish, then flies off to eat in peace. The water is again calm, still, seemingly lifeless.

A Magnificent Microcosm

Yet, hidden below the water's surface, microscopic life continues to vibrate in a fantastic frenzy. Helicopter-like bodies that could fit a hundred times over in a drop of water spin at dizzying speeds. S-shaped wriggling beings, smaller than the tiniest worm visible to the naked eye, creep about, extending and contracting their bodies. Cylindrical-shaped creatures, just a few micrometers long, create miniature whirlpools with tiny pulsating hairs on their mouths to filter in their prey.

These individual beings, collectively called plankton, are the very basis of the food chain. Indeed, if it weren't for them, the green heron you enjoyed watching catch its prey, the bullfrog you hear bellowing on a warm summer's evening, and the painted turtle you catch sunning itself would not exist. "Everything bigger that lives in the water is ultimately supported by plankton," says Phil Ross, aquatic toxicologist for the Illinois Natural History Survey.

Plankton is a collection of millions of plankters—microscopic bacteria, plants, and animals that live freely on the water's upper levels. "Plankton can be found in all surface water whether it's a puddle, a pond, or the ocean," says Ross. Plankton even exists in the water in your birdbath. You can find some of the same species of plankton at the surface of the Cache River wetlands that you can find in Europe and Asia."

The plankters' link with the food chain, their incredible beauty when observed through a microscope, and their various reproductive and feeding strategies make them intriguing for scientists such as Ross. Indeed, the study of plankton even helps our understanding of pollution and other environmental concerns.

The word plankton comes from a Greek word meaning "wanderer." And although some plankters can swim, they are so tiny that they are often at the mercy of the water's current, propelled wherever and however the wind blows. Thus, plankters live more readily in standing water than they do in moving streams and rivers.

Although the human eye can detect the larger plankters, a microscope is essential for viewing their intricate detail and beauty. Many are transparent; when you view them through a microscope, you can see internal organs such as their digestive tracts, their eggs, even their beating hearts.

You can also observe how some plankters propel themselves through the water in search of food. Rotifers, for example, are fascinating to watch as their tiny hair-like appendages (called cilia) beat in a steady, wave-like fashion to create images of spinning wheels.

"It's exciting," says Ross. "The animal is there, but you can't see it until you put it under a microscope. And then you can see, for instance, the cyclops, pulling itself through the water with helicopter-like appendages on its head."

At first a drop of pond water viewed under the microscope may seem to be just a drop of water. But then a tear-drop-shaped creature comes speeding by, doing figure-eights on its way in and out of your vision. Creatures shaped like lemon slices may float by. Or a worm-like being may wriggle beneath the lens.

"The real beauty on this planet is the microscopic world we can't see with the naked eye," says Linda Curtis, environmental biology instructor at College of Lake County in Grayslake. Curtis annually takes her class out to gather pond water for viewing plankters under the microscope. They may see, for instance, the beautiful patterns on the shells of diatoms, a type of phytoplankton or plant plankter.

"Diatoms are incredibly intricate and beautiful under a microscope—as intricate and beautiful as the stained glass windows of Notre Dame Cathedral in Paris," says Ross. He has, as a matter of fact, slides of diatoms and stained glass windows that look remarkably similar.

People living in the Victorian era recognized the wonders of the invisible world of plankton, says Curtis. Many owned microscopes and arranged diatom shells with the point of a needle to make beautiful designs which they would show their friends.

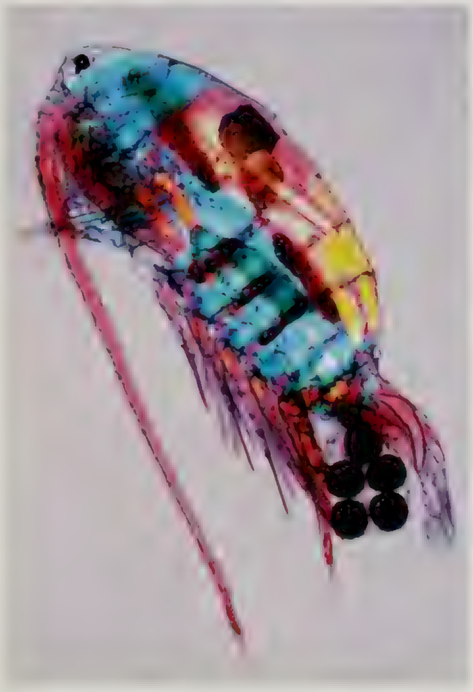
The Base of the Food Chain

Diatoms are at the very bottom of the food chain along with other phytoplankters and bacterial plankton. Phytoplankters are incredibly small, diverse plants that capture energy through photosynthesis, converting sunlight, carbon dioxide, and water into carbohydrates just as leaves on trees do. "You might find as many as 150 species of phytoplankters in one cup of pond water," says Ross.

These phytoplankters are eaten by herbivorous zooplankters—animal-like creatures with sieve-like appendages. Carnivorous zooplankters will munch on other zooplankters. Larger zooplankters provide nourishment for minnows and small fish, which, in turn, are eaten by larger fish. The green heron then completes the chain by eating the larger fish.

Similar food chains occur in the world's oceans, seas, and other bodies of water, including Illinois' wetlands. The chain becomes more complicated as some zooplankters feast on both phytoplankters and other zooplankters and certain fish eat plankton at one stage in their lives and other non-plankton treats as they grow.

Plankton is an essential ingredient in the water's ecosystem. It takes thousands of pounds of plankton to add one pound of growth to a heron. Consider that 90 percent of the energy contained in a food source is converted to heat when a animal eats it, leaving approximately ten percent of the energy for its predator.



Rakosy's microscopic photography captures the female cyclops, its egg sac bulging. These tiny creatures have one large eye as did the mythical giants they are named for.

Start with 10,000 pounds of algae, a type of phytoplankton. The algae would provide 1,000 pounds of energy for its predator, daphnia, a zooplankter. Small fish, such as sticklebacks, consume daphnia and get 100 pounds of growth for every 1,000 pounds of daphnia. That would convert to ten pounds of growth for their predators, perch—ending up with one pound of growth for a heron that eats the perch.

A Variety of Lifestyles

Birds such as herons reproduce sexually through mating, followed by the laying and hatching of eggs. But some plankton can reproduce both asexually and sexually.

Phytoplankters reproduce rapidly through cell division. Diatom cells, for example, are formed of two halves, one of which fits over the other like a box lid. When they divide, usually at night, the two halves separate and a new second half grows on each of the two new cells.

Most phytoplankton cells live only a few days, some for just a few hours, giving them little time to reproduce any other way. Still, on rare occasions, diatoms and other phytoplankton will actually reproduce sexually. A male and female merge to form what is called an auxospore, which develops into a new diatom.

The film of green or blue-green algae you might see on the surface of ponds is actually thousands and thousands of cell-dividing plankters. Normally most phytoplankton growth gets gobbled up by zooplankters; however, polluting nutrients such as phosphorous and nitrogen can cause huge algae blooms that grow too fast for zooplankton to eat. "Then the algae die, sink to the bottom of the pond, and their decomposition consumes oxygen that fish need to survive. So fish die," says Ross.

When kept in check, however, algae and other phytoplankton provide nourishment for herbivorous zooplankton such as the daphnia or water flea, which

Volvox, a type of algae, is often seen as green, fuzzy growth on submerged logs and rocks in ponds. These simplest of plants contain chlorophyll and, through the process of photosynthesis, convert solar energy into the chemical energy that is stored in food.

are filter feeders. Appendages on their mouth parts create a current of water which sweeps in food. Daphnia, as well as other filter feeding plankters, can sense what's inedible. They bend their stomachs and use sharp claws to fiercely eject unwanted particles back into the water, like a baby spitting out its food.

Female daphnia and other plankters can produce eggs alone without any help from males through a process called parthenogenesis. The eggs hatch inside the female. Then she gives birth to live young, miniatures clones which in turn eat phytoplankton to grow and mature.

"It's a quicker, simpler, easier way to reproduce than finding males," says Ross. "There's less wasted energy." However, daphnia can also reproduce sexually. When the amount of light in the day shortens and the water temperature drops, heralding winter, male daphnia begin showing up to fertilize what become the female's "resting eggs." These eggs, which contain hardier, cold-resistant shells, will fall to the bottom of the lake and hibernate until spring when they will hatch.

Cyclops, a carnivorous zooplankter, has one large eye spot, hence its common name, taken from the one-eyed creature of Greek mythology. Cyclops, of which there are a least 40 different species, reproduce sexually, as do most higher order zooplankton. The larva of some cyclops species jump in and out of view under the microscope, then float for a while quietly, buoyed up by long hairs. Remarkably adaptable, some species of cyclops occur all the way to the Arctic Here in Illinois, they bear two generations of young that grow to adulthood within the six-month-long growing season. Farther north, the same species will reproduce only one new generation per year.

In the Arctic, each life cycle takes two years. The animal is unable to reach sexual maturity before it must retreat from the pending frigid winters. It hibernates in an immature state, completing its cycle after the next spring thaw.

In the Interest of Science

While plankters such as diatoms, daphnia, and cyclops provide a source of fascination and help in our understanding of the food chain, they also serve an important role in evaluating what is happening to our environment. Diatom shells, for example, may provide clues on the study of acid rain and pollution. Certain types of diatoms thrive in more acidic conditions, while others need a less acidic environment. Because their brittle silica shells do not decompose, diatoms can provide a view of life dating back tens of thousands of years to help scientists chart the cycle of water acidity.

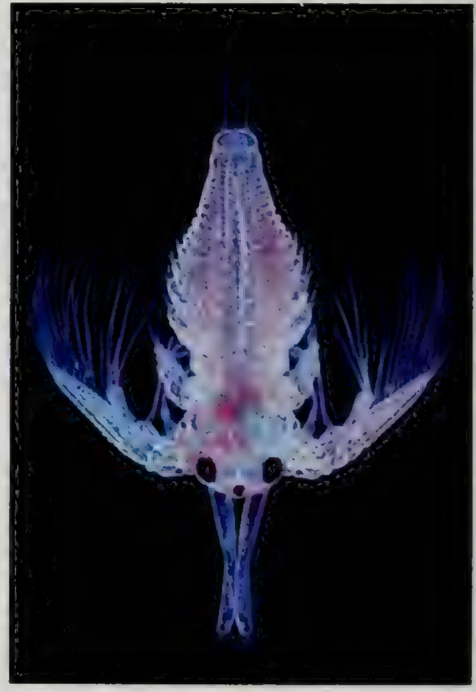
"You can discover which kind of diatoms existed through time and then you can determine whether the level of acidity in water is just part of a natural progression on earth," says Ross.

The world of plankton is opening up to scientists now more than ever. Newly refined plankton nets enable scientists to trap and study smaller and smaller plankters, and, with the development of electron microscopy, scientists can focus on units as small as one scale on the shell of an individual plankton cell. Perhaps more secrets will be discovered by examining these invisible beings that start the chain that enables us to enjoy the green heron partaking of an afternoon meal. ■

*You can view the hidden world of plankton through January 1992 at the **Chicago Academy of Sciences**, 2001 North Clark St. in Chicago. There you will discover, **"Plankton Portraits: Life in a Water Drop,"** an exhibit featuring the microscopic photography of Alex Rakosy of Riverdale.*

Sheryl De Vore is a nature and environment writer for Pioneer Press Newspapers in Bannockburn. Although birding is her first love, she has enthusiastically pursued the study of plankton for this article.

Photos and caption information courtesy Alex Rakosy and The Chicago Academy of Sciences



This microscopic juvenile fairy shrimp, called a naupilius, is found in ponds and temporary pools during the first few weeks of spring, often appearing while the water is still covered with ice.

SURVEYING ILLINOIS

BIORHYTHMS

Illinois Natural History Survey (INHS)

On the Lookout for Badgers

During the past ten years, evidence of badgers has been found in most Illinois counties. Survey researchers are now identifying the primary badger regions within the state and investigating the ecology of badgers that live in widely different regions representing various environmental conditions. Badger adaptations for a fossorial (adaptation to digging) lifestyle include a wedge-shaped head on a short neck, large membranes that protect the eyes from dirt, short erect ears protected by long hairs, partially webbed toes, and two-inch curved claws.

Badger (Susan Post photographer)

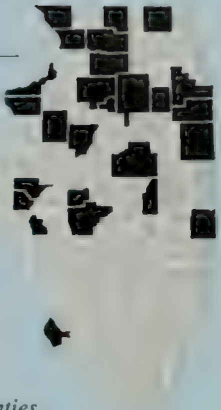
Because badgers are primarily nocturnal, they rarely come in direct contact with humans, and their presence goes undetected unless they dig near human residences. Badgers are known for their pugnacious personalities and are more than willing to hold their ground with any mammal that disturbs them. They pose little danger to humans, but other animals that meet up with badgers and don't retreat promptly are likely to become the badger's next meal. The highly transitory behavior of badgers—they are often here today and gone tomorrow—often proves frustrating for researchers. If you are aware of badger sites or activity, contact the Natural History Survey at (217) 333-5199.

Aquatic Plants: A Balancing Act

The layer of green algae on the surface of a quiet pool and the seemingly endless platelike lotus leaves that cover the water are the primary producers of energy in lakes, ponds, and rivers. These plants need sunlight and carbon dioxide to live and grow, and they release oxygen, essential to other life in the water. Aquatic plants also provide food and habitat for organisms living in the water and on land. Large plants rooted in pond and lake bottoms help stabilize sediments and temper the force of waves, thus reducing erosion along shorelines.

Sediments, washed mainly from adjacent farmlands, continually enter ponds, lakes, and rivers and deposit nutrients, often in excessive quantities. These nutrients often lead to early season algal "blooms" that can reduce penetration of light sufficiently to limit or prevent the growth of large, submerged plants. If, however, these submersed plants can take advantage of the overabundance of nutrients, they also develop abundant populations. The balance between aquatic vegetation and the surrounding ecosystem is delicate but crucial, and either too much or too little vegetation jeopardizes the entire system.

Yellow pond lily



Illinois counties with reports of deer ticks as of December 1990.

And Better Look Out for Deer Ticks!

The deer tick, which spreads the bacteria that cause Lyme disease, has expanded its range in Illinois and been found, for the first time, in the southern third of the state. Since 1987 the deer tick has been found in 26 Illinois counties. The tick's distribution is determined by INHS researchers and by volunteers who examine deer kills at deer check-stations during the hunting season. More than 5,000 deer were closely examined for ticks in the 98 counties that allow firearm hunting.

Anyone engaged in outdoor activities in tick-infested areas (see map) should take precautions against tick bites. The best protection is to wear sturdy shoes, long pants with cuffs tucked into socks, and a long-sleeved shirt. Although this may present a less than fashionable appearance, it will minimize the likelihood of tick bites. For additional protection apply tick repelling sprays to clothing

CURRENTS

Illinois State Water Survey (ISWS)

The Scars of the Beautiful Cache River Basin

"One of the most unique and important areas in the nation" is how a State Water Survey report describes the Cache River Basin. But, as ISWS principal scientist Mike Demissie notes, "its complex hydraulic system presents tremendous problems to researchers."

Demissie, who is in his ninth year of studying the basin, says that flooding and poor drainage of nearby farmlands have been troublesome for years. "A number of major channelization and levee projects have turned wetlands into farmland."

When the Illinois Department of Conservation (DOC) called in the Water Survey in 1982, it was the beginning of scientific documentation in the Cache River Basin. By the mid-1980s, Water Survey studies had helped to resolve a bitter conflict between the state and the drainage district. Demissie says, "The data showed clearly that activities to drain the wetlands just wouldn't do what the district wanted anyway. The only impact would be to complete the destruction of the wetlands."

The Water Survey's expert testimony in court helped bring about an injunction to halt a bank-clearing project on the Lower Cache, and, in an out-of-court settlement, responsibility for maintenance of the channel under dispute was shifted from the drainage district to the DOC.

At about the same time, there was concern that gullies, formed by the entrenchment of Upper Cache channels, would drain Heron Pond, killing its ancient trees. The Water Survey recommended that the gullies be stabilized with crushed rock and gravel. "It did the trick," says Demissie.

Demissie explains that wetlands are important not only for the diverse biological communities they harbor, but also because they serve valuable hydrologic functions such as flood control, entrapment of sediment and nutrients, water-quality improvement, groundwater recharge, stabilization of streambanks, and erosion control.

Cypress trees grow in 2,000-acre Horseshoe Lake, one of several ISWS projects funded by the federal Sportfish Restoration Act through the Department of Conservation. According to Ming Lee, ISWS researcher, the lake has lost one-third of its volume since 1951 because of sand, silt, and clay sediment deposits. ISWS is recommending management strategies to eliminate sedimentation and raise the level of the lake. The 9,500-acre Horseshoe Lake Fish and Wildlife Management Area is the winter refuge for 100,000 Canada geese and has been a popular recreational area in southern Illinois since the 1920s. (Courtesy ISWS)

Sediment can affect the complex food chain that feeds the biotic system of rivers. For example, soil particles diffuse sunlight, which in turn prevents or reduces photosynthesis. Sediment can also introduce contaminants that are deadly to fish and introduce nutrients that stimulate so much plant growth that the oxygen level in the water is reduced. Silt can fill fishes' gills, strangling them, and has been known to destroy fish spawning grounds.

Water Survey researcher Rich Allgire with water monitoring and sampling equipment at an overpass on the Cache River (Courtesy ISWS)

Ongoing ISWS data collection and the development of mathematical models have resulted in recommendations to stabilize some of the Upper Cache River channel and control the flow of sediment into the Lower Cache River wetlands. The first structures are in the design phase and should be ready for installation by 1992.

The data that Demissie and his colleagues have collected have proved valuable not only to the DOC but also to other agencies conducting wetlands studies: The Nature Conservancy, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service.

Geologists collecting surface data (ISGS photo)

GEOGRAMS

Illinois State Geological Survey (ISGS)

Geological Mapping Pays!

The ISGS has assessed the benefits and costs of statewide geologic mapping programs as required by the 1991 Illinois Senate Resolution 98. Using the documented cases of Boone and Winnebago counties and taking into account the variations in geology and regional mapping needs, survey geologists estimate the cost of a statewide mapping program would range from $21 to $55 million.

A high price to pay? Not according to Dr. Subhash B. Bhagwat and Dr. Richard C. Berg, authors of the study,who feel the benefits of geological mapping clearly justify the cost. They point to direct benefits that accrue from the wise selection and design of waste disposal and industrial sites, sound urban development and zoning decisions, planning of mineral exploration and extraction strategies, and assessing infrastructure needs. Indirect benefits include avoidance of land and water contamination, the implementation of public health improvements, and public education. While some benefits are quantifiable, many are difficult to translate into dollars.

Based solely on the projected savings derived from avoiding future costs of cleaning up waste disposal and industrial sites, statewide benefits could be between $64 and $148 million on an investment of $21-$55 million for an appropriately detailed geologic mapping program. Many other benefits were monitored and listed although not included in these projections. Benefit/cost ratios might well increase if such benefits were quantified and included in the calculations.

The study is available as ISGS Open Files Series 1991-5 and is being edited for publication as Circular 549.

Mineral Resource Search

What's the likelihood of finding new mineral resources—or extensions of known deposits—in southern Illinois? To answer this question, the ISGS is participating in the Conterminous U.S. Mineral Assessment Program (CUSMAP) of the U.S. Geological Survey (USGS). CUSMAP provides detailed geological, geochemical, and geophysical studies in regions known to contain—or have potential for—mineral deposits.

The project, begun in 1986 in cooperation with four state geological surveys and the USGS, focuses on the 7,500-square-mile Paducah quadrangle, which covers a section of southern Illinois and adjacent parts of Missouri, Kentucky, and Indiana.

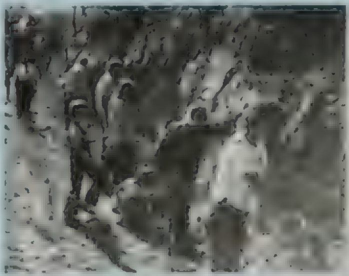
(Department of Energy and Natural Resources photo)

A preliminary assessment of mineral resources within the Shawnee National Forest—fluorspar, metals, absorbent clay, kaolin, sand and gravel, coal, oil, and gas—was carried out with the USGS in Denver last October, and this past spring, researchers from the state geological surveys and the USGS met to construct and evaluate conceptual models of mineral occurrence in the study area. The ISGS demonstrated the effectiveness of the Illinois Geographic Information System (GIS)—a computer system which creates multi-dimensional, layered maps from bedrock up to surface features—to produce final assessment maps which show the relative potential for occurrence of previously unknown deposits.

Results of the project will be made public in 1992. They should enable industries to assess the benefits of investing in Illinois, and they can serve as the basis for wise policy decisions by state and federal agencies.

Field Trips Slated for 1991-92

Field trip geologist Dave Reinertsen will introduce groups to the geology of Pere Marquette State Park on the scenic Illinois River in the western part of the state on October 26, 1991; Cave-in-Rock on the Ohio River in southern Illinois in April 1992; and the Galena area in northwestern Illinois in May 1992. To obtain a brochure about these free trips, contact ISGS, 615 E. Peabody Dr., Champaign, IL 61820-6917, or call (217) 333-4747.



Field trips attract geology enthusiasts of all ages (ISGS photo)

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

Left Over Paint—What a Waste!

Illinois ranks among the top five states in the nation in the production of paints and coatings. Few of us are aware of the quantity of waste generated in both producing and applying paint.

The Illinois General Assembly has required that HWRIC identify options for waste reduction in the manufacture and use of paint, make recommendations for education programs focusing on the reduction of paint-related wastes, and make recommendations for legislation aimed at reducing and better managing such wastes. Concerns include air pollution from such sources as solvent evaporation and liquid wastes from spills, off-spec batches, and oversprays. Solid wastes also take up landfill space and may pose a threat to groundwater.

To fulfill the state mandate, HWRIC is polling more than 500 Illinois companies (paint manufacturers, users, and removers) to determine the amount and types of waste they generate and how the waste is managed. HWRIC also makes on-site visits to selected manufacturers to seek out innovative pollution prevention techniques that can be shared with other companies. An Ad Hoc Advisory Committee made up of members of industry, trade associations, and environmental groups will review the project and its results and provide advice.

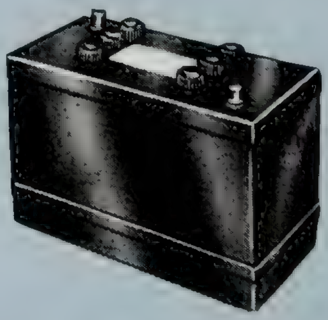
In the meantime, here are some recommendation from the National Paint and Coating Association:

- Figure out what each job requires and buy only what you need.
- Use all of the paint you have purchased by applying a second coat or using it for touch-up.
- Give left-over paint—in its original container, label intact—to someone who can use it.
- Never pour thinners, turpentine, mineral spirits, and solvents down drains or storm sewers. You can reuse them if you let the used turpentine or brush cleaner sit in a closed container until paint particles settle. Pour off the reusable clear liquid and return it to the original container, or label the new container clearly. In Illinois, it is legal to dispose of the dried paint residue in the household trash.

For assistance in finding waste disposal programs in your area, check the Yellow Pages under "waste disposal," or contact HWRIC, One Hazelwood Drive, Champaign, IL 61820, 217/333-8940 and ask for the pamphlet ***Paint Disposal...the Right Way****.*

Getting the Lead Out

Spent batteries are a problem because they leak and are dangerous to handle. It is also illegal to dispose of them improperly. ***Used Lead-Acid Batteries: Management Tips*** is available free from the HWRIC Clearinghouse (217/333-8940). The publication is the first in HWRIC's new "Pollution Prevention" series. It provides information on regulations governing lead-acid batteries and gives management tips for businesses (particularly automotive maintenance shops) and for homeowners. This publication includes a three-page list by county of smelters and battery recycling centers in Illinois.



TNT Poses Wastewater Risks

TNT has not been manufactured in the U.S. for the past several years. The "redwater" generated during its production—as suggested by its ominous name—is hazardous.

In a joint project with the U.S. Army Construction Engineering Research Laboratory, a redwater treatment technology called Wet Air Oxidation is being evaluated in HWRIC's Hazardous Materials Laboratory. The goal is to render, through appropriate treatment, a wastewater acceptable for disposal under federal environmental laws. HWRIC scientists are developing methods to measure the hazardous components in redwater before and after treatment.

In a separate part of the study, Natural History Survey scientists will evaluate redwater toxicity. Applying an established group of toxicity tests, these researchers will monitor the effectiveness of the treatment processes at various stages of the HWRIC research project.

The chemical and toxicological tests will help define the optimum operating conditions for the Wet Air Oxidation process and its potential for application to redwater treatment on a production scale. Development of a successful treatment procedure for redwater is a critical first step to producing TNT again in the United States.

SOUTHERN EXPOSURE

A Record of Human Activity in the Shawnee Hills

by David Foster

South of U.S. Highway 50, about parallel with St. Louis, the Illinois landscape begins to change. The expansive grand prairie that is the heart of central Illinois gives way to the gently rolling Mt. Vernon Hill Country. Here, wide stream valleys alternate with low hills on a landscape only lightly altered by glaciation. The subtle change from prairie to hills prefigures a more dramatic change when the Mt. Vernon Hill Country gives way to the powerful and imposing Shawnee Hills. Cutting across the southern part of the state from the Mississippi to the Ohio River, the unglaciated Shawnee Hills are best described as a rugged escarpment, approximately 800 feet high, made up of 300 million-year-old sandstone. It is an area of magnificent vistas, tall bluffs, deep canyons, fascinating rock formations, forest, woodland, and swamp habitats, clear streams, and unusual flowers. It is unlike most of Illinois and is one of the state's most scenic regions.

The Early Years

To the casual observer the Shawnee Hills appear almost unspoiled in their native beauty, but settlement in the area predates any distinctly U.S. activity and takes us back to the beginnings of human life on the North American continent. At Modoc, in Randolph County, just a few miles northwest of the Shawnee Hills, artifacts at least 10,000 years old have been found. Several miles north of the Modoc site is Cahokia. This large urban complex flourished roughly between 900 and 1250 A.D. and influenced settlements throughout the Mississippi valley. Estimates of its population range from 20,000 to 40,000.

Miners waiting for transportation in a Saline County mine, c. 1920 (ISGS photo)

When explorers and settlers of European extraction arrived in southern Illinois after 1673, Cahokia and other mound-building communities were already gone, having vanished so completely that even contemporary Indians were unaware of them; their native American successors, however, continued to use the Shawnee Hills as their forbears had. They hunted, mined, and farmed.

The French entered southern Illinois in the late 1600s and eventually developed a string of settlements in the Mississippi River valley. Though in possession of southern Illinois until 1763, the French never colonized to the degree their English counterparts did on the Atlantic seaboard. Their Illinois settlements remained small. French economic activity centered on grain farming and fur trading.

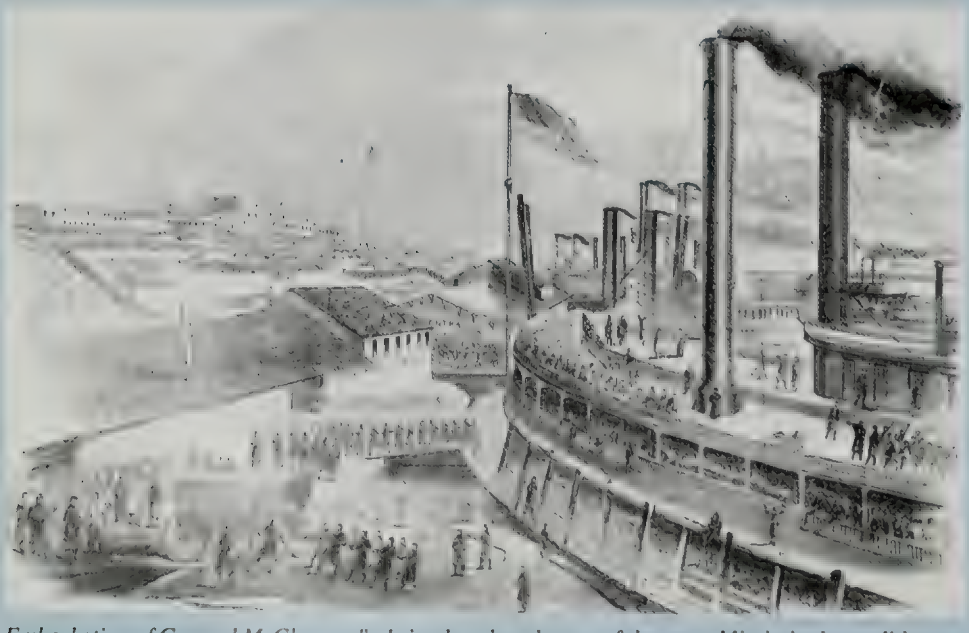
From 1763 to 1783, southern Illinois was in British hands, but then control passed to the United States. Penetration into southern Illinois by American explorers and settlers began before 1800 and quickened after various Indian cessions were made during the first ten years in the 19th century. These settlers were mostly Southerners, coming from Kentucky, Tennessee, or the Carolinas. They settled in the river valleys and wooded groves near the streams. The Ohio River was the major transporta tion artery, and a number of settlements grew up on its banks.

The early pioneers looked for wooded areas to settle because the riches of the prairie were as yet unknown and trees were an absolute necessity for any successful settlement. Trees were used for fuel, to construct fences, to build houses, and to power primitive industries. Trees also had to be cleared to allow for farming. The resulting deforestation was devastating to the Shawnee Hills. The loss of tree cover exposed the soil to easy erosion, and, in some parts of the Shawnee Hills, rain runoff cut gullies as deep as nine feet and much valuable top soil was lost. Because Shawnee Hills soils are without the nutrient-rich glacial deposits of the rest of the state, the problem of erosion has severely limited agricultural productivity. As a consequence, agriculture has not been widely successful in the Shawnee Hills, and widespread abandonment of farm land began as early as the late 1800s. A second growth of trees covers many of these abandoned lands.

Farmers, of course, were not exclusively responsible for deforestation. Some of southern Illinois' earliest industries were heavy wood users. Salt, plentiful in the saline springs of Gallatin County, was extracted from brine by boiling. When all the trees nearest the springs had been used as fuel, wooden pipelines were constructed to carry the brine to other, as yet uncut, trees. By 1828, five such salt works were in operation. These operations flourished for a number of decades, but, due to increased competition from other non-Illinois sources, ceased production by 1875.

The smelting of iron ore was a similar wood user. Smelting furnaces were constructed in Hardin and Jackson counties to create pig iron from local ore deposits. The first such mine opened in 1837 and the last closed in 1883. Charcoal was the primary fuel.

Trees, however, were only one victim of settlement. A guide to the state of Illinois printed in 1837 already lamented the loss of buffalo, elk, bear, and otter. Birds were also decimated by early settlers. Market hunting left the Shawnee Hills devoid of partridges, swans, pelicans, cranes, and passenger pigeons, just to mention a few. These birds were hunted and sold in the markets of big cities primarily as food, though their quills and feathers were also in demand. The loss of forest habitat is also partly responsible for the disappearance of these birds and animals, but indiscriminate hunting remains the primary culprit.



Embarkation of General McClernand's brigade—the advance of the great Mississippi expedition during the Civil War. (From Harpers Weekly; courtesy of the Illinois State Historical Library)

This early environmental crisis was paralleled by a far more obvious spiritual crisis that haunted southern Illinois during the first half of the 19th century: the crisis of slavery and the Civil War. Slavery was an early divisive issue in southern Illinois where it existed legally in the French regime and then under a semblance of legality during the early years of statehood, when slaves could be used as contract laborers or indentured servants. Southern Illinois was the center of support for the unsuccessful attempt to amend the constitution in 1824 to legalize slavery. During the spirited senatorial election between Lincoln and Douglas in 1858, southern Illinois, having heard one of the famous debates in Jonesboro, remained strongly pro-Douglas. In 1861, an attempt to create a separate, pro-confederate state in southern Illinois took place in Williamson County, and what is now Giant City State Park was a refuge and hiding place for many confederate sympathizers.

This, of course, is not the whole story. For all those with confederate leanings in southern Illinois, there were even more dedicated to a free Union. Many southern settlers had come to Illinois precisely because it was free. After the war began, thousands of pro-Union Southerners from war-torn areas flooded southern Illinois, seeking refuge in such towns as Anna, Jonesboro, and Centralia. Northwest of the Shawnee Hills, an underground railroad route existed from Rockwood in Randolph County to Carlyle in Clinton County, and southern Illinois enlistments in the Union army were, throughout the war, above national quotas. The full extent of the tension caused by these divided loyalties can only be guessed at, but it is

View of a busy main street in Belknap, c 1905. Sawmill towns prospered in the Cache River Basin until the virgin timber was gone. (Photographer unknown, courtesy Max Hutchison)

safe to say that nowhere else in Illinois was the agony of the Civil War more keenly felt than in these southern Illinois counties.

Mineral-Rich Hills

Another major activity that has affected and continues to affect the Shawnee Hills is mining. This is a mineral-rich area, and the mining of a number of minerals—such as fluorspar, kaolin, silica, and fuller's earth—began in the 19th century. These minerals continue to be important in the local economy, but according to Jim Baxter of the Illinois State Geological Survey (ISGS), their extraction is not particularly damaging to the environment. The areas mined tend to be small in size, with few or no harmful by-products. Abandoned mine areas are also being successfully reclaimed, and the existence of untapped reserves of these minerals is highly probable. (See Geograms, page 11.)

The mineral usually associated with southern Illinois, however, and which still looms so large in its economy is coal. The first shipment of coal from a commercial mine near Murphysboro dates from 1822, and by 1840 commercial mining was becoming well established.

The surface mining of coal is especially damaging to the landscape, but since the early 1960s, the reclamation of mined lands has been mandated by law and many reclaimed lands have been successfully returned to their natural, pre-mining state. Heinz Damberger of the ISGS points out that surface mining involves no change in the composition of materials at the mine site, only in the arrangement of those materials. There is little danger from the drainage of surface mining sites because any acid is neutralized by a heavy limestone overburden. The main potential source for acid drainage in Illinois is from refuse material of coal cleaning plants, and, according to Damberger, this is a localized problem with little ramification for the larger region.

Coal mining's effect on southern Illinois has been more than environmental. Violence was an early legacy, and Williamson County has the distinction of being the location of one of the most notorious examples of labor violence in the United States. In 1922, coal miners were on strike across the country, and for reasons not entirely clear, the United Mine Workers local allowed a mine near Herrin to operate during the strike as long as the coal remained unshipped until after the strike was settled. Known strike-breakers were brought in to work the mine, and it soon became apparent to the striking miners that the company would ship the coal whether the strike was settled or not. Their outrage reached the breaking point when one of the striking miners was killed from a shot believed to have been fired by a coal company guard, setting off a bloody chain of events involving thousands of miners. In the end, the mine superintendent, a reputed union-buster, was summarily shot

Old Shawneetown, once the largest town in Illinois, after the waters of the Ohio River flood receded in spring of 1937 (ISWS photo)

and 18 scabs, unarmed and defenseless, were brutally slaughtered. A total of 214 miners were indicted for murder; not a single one was convicted.

The Birth of a National Forest

Widespread unemployment in the mining industries and the continued failure of marginal farming operations made the Great Depression especially severe in southern Illinois. The creation of the Shawnee National Forest in 1939 was partly a response to this situation. The government became a ready buyer for much of the least productive land and embarked on the huge task of forest reclamation. More efficiently managed timber industries and the development of recreational sites also helped the local economy.

Although an extensive second generation of trees had already appeared throughout the Shawnee Hills by the 1930s, the Forest Service continues to restore trees to lands where tree cover has been removed and the most serious erosion has taken place. Loblolly and shortleaf pines have been planted as a short term solution to keep valuable soil from continuing to wash into the Mississippi and Ohio rivers; these pine forests are slowly being converted to the original hardwood forests of pre-settlement days. The Forest Service has also restored some original ecosystems or habitats where feasible. Not all of the forest area was heavily wooded in pre-settlement days; some areas, called barrens and glades, consisted of relatively open areas dotted with an occasional stunted oak and a ground cover of various dry grasses and vegetation. Through careful seeding and controlled burns, some of these natural remnants have been restored.

In all fairness to the residents of the Shawnee Hills, both past and present, much of the area's decline must be blamed on factors beyond its control. The opening of the Erie Canal in 1825 shifted population movement in Illinois to the north. The emergence of Chicago as a transportation hub confirmed the importance of east-west trade routes over north-south ones. The appearance of railroads doomed the river ports to limited growth. Improvements in the plow and other farming techniques shifted agricultural activities to the prairies of central and northern Illinois. But perhaps most significant have been the rivers that brought southern Illinois to prominence in the first place. Kaskaskia, Illinois' first capital, was located seven miles from the Mississippi on the banks of the Kaskaskia River, but during a serious flood in the late 1800s, the Mississippi appropriated the channel of the Kaskaskia, expanded it, and literally drowned the town. Likewise, Shawneetown, on the Ohio River at the entrance to the Shawnee Hills from the east, was so devastated by the Ohio River flood of 1937, that the city was moved three miles inland. Old Shawneetown, once the largest town in Illinois whose confident bankers reputedly snubbed a delegation of Chicagoans looking for a loan, is now a ghost town, its once important buildings almost totally gone and its main street a picture of decrepitude.

But it may very well be that the Shawnee Hills are most threatened by climate change, especially global warming. Wayne Wendland of the Illinois State Water Survey says that a permanent increase in temperature of just a few degrees would cause the bulk of the forest, except along river banks, to migrate slowly to northern Illinois or southern Wisconsin, where rainfall and temperature would be more similar to that which the forest experiences now. What would remain of the Shawnee Hills would be more dry grassland than forest.

Perhaps it is unimportant to know whether local residents, outside forces, or the future will have the greatest impact on the Shawnee Hills. Perhaps it is enough to know that this historically significant and resource-rich area remains a gem in the landscape of Illinois, still largely unknown and underappreciated, where federal, state, and local agencies are carefully managing the sometimes contentious interplay between natural and human forces. It is safe to say that despite years of use and abuse, the Shawnee Hills are looking very good. May they continue to be an Illinois showplace. ■

David Foster works as curator of geography for Encyclopaedia Britannica in Chicago but has close family ties to southern Illinois.

INTO THE WOODS

by Bill Furry

Far above the rain-swollen river valley, scrub cedars jut precariously from age-old limestone cliffs. Fingers of sunlight reach timidly through the dense canopy of hickory and oak trees, stretching to caress the leaves and petals of wildflowers and delicate ferns on the forest floor. Overhead, silver-winged turkey vultures glide effortlessly on the updraft, silently cutting through the humid, mid-morning air.

Three hundred and fifty feet below and to the west, a dense yellow-green carpet of microscopic flowers floats languidly atop the pristine waters of a spring-fed swamp. Along the shoreline, indigo buntings and yellow-breasted prothonotaries reveal their hiding places in quick flashes of brilliant color, their brief songs echoing from the bluffs back to the distant treetops.

This is the Shawnee National Forest, a 261,357-acre federally protected woodland in southern Illinois. Although it is one of the nation's smallest national forests, the Shawnee is the most biologically diverse area within the state. It is also the most scenic.

The native columbine is often found growing on relatively steep slopes in ravines and along bluff edges and can form spectacular assemblages in late spring.

Cradled in the arms of the Ohio and Mississippi rivers, the 1,308 square-mile forest touches nine counties and encompasses 55 separate ecological areas ranging in size from the two-acre Split Rock Hollow to the 2,585-acre LaRue-Pine Hills in Union County (described above). The federal forest is also the home of Bell Smith Springs and Ferne Clyffe, as well as eight other federal recreation areas and a half dozen state parks. It is a vital landscape bursting with natural beauty, literally as old as the hills.

Grits and Crayfish

The "southern" in southern Illinois isn't simply a geographic demarcation. The adjective has cultural, political, and social applications as well. Cairo, for example, the state's southernmost city, is 36 latitudinal minutes (about 41 miles) deeper into Dixie than is Richmond, Virginia, the Confederate capital of the American Civil War. Some 240 miles south of Abraham Lincoln's home in Springfield, Cairo is closer to Vicksburg, Mississippi, than it is to Chicago. But the region's most distinguishing features are geologic, not cultural.

According to Larry Page, biologist for the Illinois Natural History Survey's Center for Biodiversity, the unique character of southern Illinois is primarily the result of an oversight in nature.

"That part of Illinois was not glaciated," says Page, referring to the great ice flows that carved out the fertile Illinois prairie basin, but stopped at the northern slope of the Shawnee Hills. "Consequently, southern Illinois is the oldest biologically undisturbed region in the state. The older an area is, the more time things have to migrate there," says Page.

Nowhere in Illinois is this biological diversity more pronounced than in the LaRue-Pine Hills in southwestern Illinois, where more than 1,150 species of vascular plants (ferns, conifers, and flowering plants) are found. According to Shawnee National Forest ranger Ray Smith, that number is conservative, because it does not include the vast number of lichens, liverworts, and bryophytes found in the forest. Ninety percent of the mammals and 35 percent of the plant species known to occur in Illinois are found in the Pine Hills. Designated a National Heritage Landmark in 1975, LaRue-Pine Hills is the essence of pre-settlement Illinois, possessing upland and lowland forests, prairie barrens, cliffs, springs, caves, ponds, and a swamp.

Burden Falls, in Pope County, is spectacular in early spring when water cascades over the precipitous, boulder-strewn cliff and down the valley. By midsummer the water usually dries to a mere trickle.

LaRue-Pine Hills is home to 23 species of snakes, including the scarlet snake, a variety found nowhere else in Illinois. The copperhead, mud snake, green water snake, and timber rattlesnake are also at home here, as is the cottonmouth water moccasin in plentiful numbers. It is said that in the early spring there are more snakes slithering in LaRue swamp than there are lobbyists doing likewise at the statehouse. Twice a year (in April and October) the swamp road is closed to vehicular traffic, allowing migrating reptiles safe passage from their winter haunts in the bluffs to the lowland swamp, and back again to hibernate in the fall.

Endemic to the bluffs at LaRue-Pine Hills is the rare eastern wood rat, a bona fide pack rat that builds its nest from whatever materials it finds closest at hand. The bluehead shiner and the blind cavefish also occur in Illinois only at LaRue-Pine Hills, as do several unusual invertebrates such as the dwarf crayfish.

There are several ways to gain access to LaRue-Pine Hills ecological area, but the most spectacular view is from the Levee Road. This scenic gravel byway turns east off Route 3 about eight miles north of Ware and parallels the Big Muddy River. The approach to the bluffs from this vantage is stunning.

Once inside the Pine Hills, visitors will find well-tended nature trails of various gradations, many leading to scenic overlooks of the LaRue swamp. A designated campground with full facilities is just two miles down the bluff road. Primitive camping is permitted throughout the Shawnee National Forest, but special permits are required outside designated areas.

Larry Stritch, a botanist and heritage specialist for the U.S. Forest Service at the Shawnee National Forest main office in Harrisburg, works to preserve the integrity of the natural areas throughout the forest. Maintaining public lands for ecological research is often a tricky business. “If you don’t bring the public to the area, they’ll never see the value of spending dollars to preserve it,” says Stritch. “But if a natural area becomes too heavily trafficked, its value as a pristine research area diminishes.” The answer, Stritch believes, lies in education.

For the last five years southern Illinois environmental and nature groups have pooled their resources and expertise to sponsor the LaRue-Pine Hills Appreciation Day, held in late April. The Illinois Shawnee Nature Commission, the Native Plant Society of Illinois, the Shawnee Group of the Sierra Club, the U.S. Forest Service, Southern Illinois Audubon, and others participate in the planning and preparation of a series of excellent programs throughout the ecological area. There are guided wetland canoe trips across the LaRue swamp; workshops on edible plants, mushrooms, and wildflowers of the region; and special hikes for children.

Although all-terrain vehicles are permitted on gravel roads, they are never allowed on trails. Rappeling is forbidden, as bryophytes growing on the surface of the limestone bluffs can easily be obliterated by a single careless step. Specimen-collecting is not permitted without the written consent of the U.S. Forest Service. Hunting in season is permitted, subject to the rules and guidelines of the state Department of Conservation.

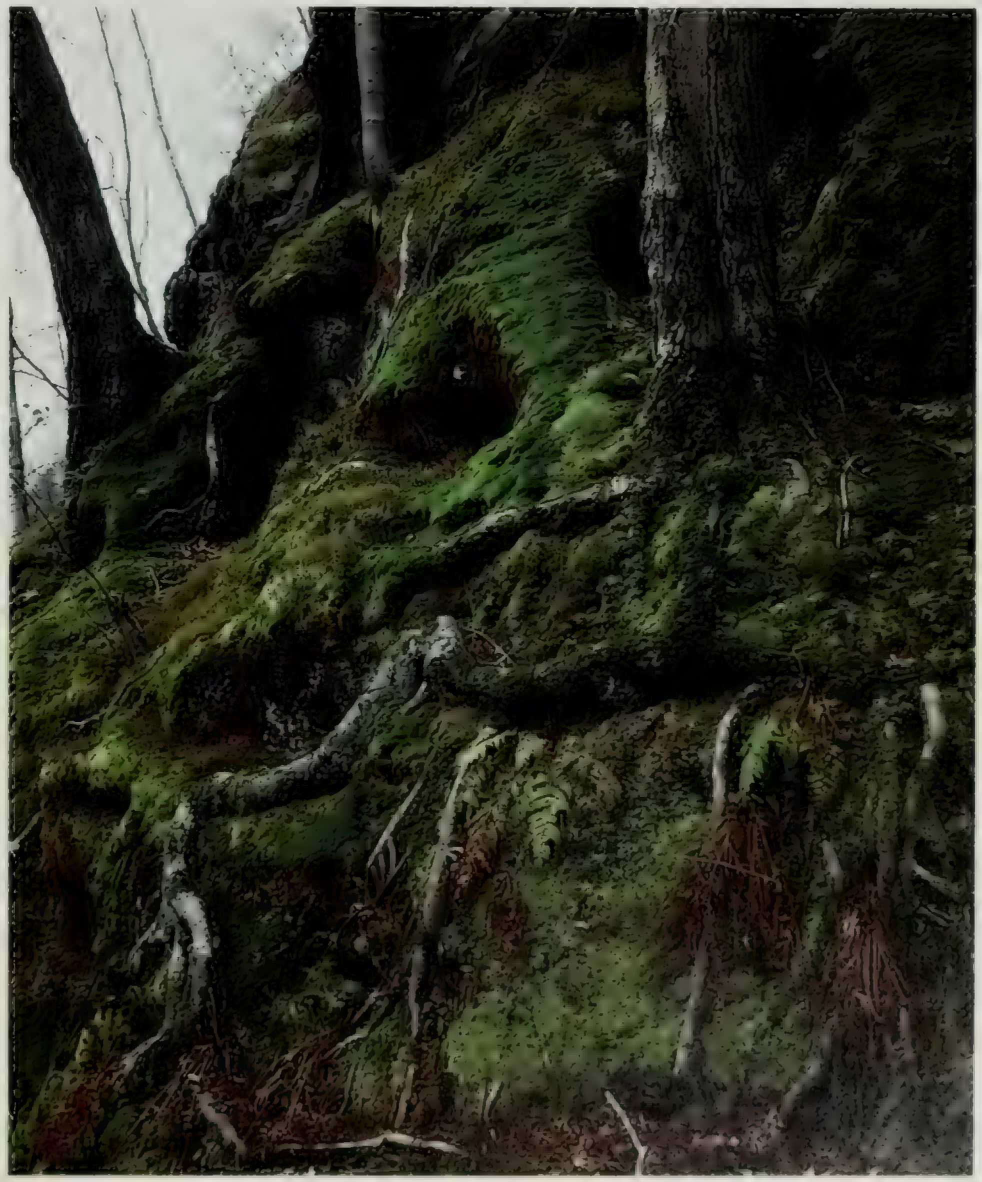
Smith says that spring and fall are the best times to visit the LaRue-Pine Hills and Page believes one of the best ways to experience the area is at night. "Pick a warm night in May," he suggests, "and bring a flashlight. If you shine your light along the bluffs on the swamp side, you'll occasionally see the burning eyes of an eastern wood rat. But the real show at LaRue after dark isn't visible, it's audible. Once the spring sun sets over the swamp, the night belongs to the ever-croaking, ever-chirping, ever-singing frogs."

A Bridge to Yesterday

About 60 turkey-vulture miles east of LaRue-Pine Hills and 30 minutes southwest of Harrisburg is Bell Smith Springs, another national recreation area known for its splendid scenery, its variety of flora and fauna, and its accessible system of trails. Unlike LaRue-Pine Hills, which gets its name from the native stands of yellow pine that dominate the forest, Bell Smith Springs is nestled among sugar maple, tulip, and beech trees and is surrounded by upland hickory and oak trees. The clear, spring-fed waters of Bay Creek flow through a wooded ravine surrounded by sandstone bluffs, making this forest island one of the most natural attractions in the state.

Bell Smith Springs Recreational Area is as well-known for its biodiversity as LaRue-Pine Hills. More than 700 different varieties of ferns and flowering plants have been identified at Bell Smith, 20 percent of the total number of such plants in Illinois, according to Southern Illinois University botanist emeritus Robert H. Mohlenbrock. Two species of thrips—small, often-wingless insects of the order Thysanoptera—are endemic to Bell Smith. In June the brilliant yellow blooms of the flowering prickly pear cactus decorate the floor of the forest, as do other succulents such as the Illinois agave and flower-of-an-hour, whose pink petals bloom for a brief 60 minutes before withering.

John Schwegman, a heritage botanist for the Department of Conservation, grew up in southern Illinois and has made a detailed study of the flora of the region. According to Schwegman, there are plants growing in the cool shade of Bell Smith Springs that botanists believe are relics from the last ice age, which retreated from Illinois some 10,000 years ago. The hay-scented fern, a threatened species in Illinois, grows along cool, shaded creek bottoms as does the plant called leatherwood. Neither species is found elsewhere in Illinois. One of the rarest of Illinois



Moist, north-facing cliff walls in Round Bluff Nature Preserves in Ferne Clyffe State Park support a relatively diverse vegetation of ferns, mosses, and even small trees. The trees become rooted in small cracks in the porous sandstone and eventually cause portions of the rock to split away plants, French's shooting star, is occasionally found along the undershade of sandstone cliffs at Bell Smith Springs.

The trails at Bell Smith Springs alone are worth a trip to southern Illinois. Starting at the parking lot at the end of Forest Road 848, hikers begin the descent into the Bay Creek canyon, walking an asphalt trail down to a series of steps cut steeply into the rock face. At the foot of the steps, a choice of trails is offered. To the left, a trail leads to such scenic spots as the natural bridge, boulder falls, and sentry bluff. The massive natural bridge is 30 feet high, 20 feet wide, and more than 125 feet long, and was slowly carved out of the sandstone by centuries of water erosion.

The trail to the right passes by deep, spring-fed pools that are welcome swimming holes on hot summer days and leads to the site of the spring for which the area was named. Beyond the spring is an old grist mill where early pioneers took corn to be ground into flour. At Hunting Branch is a picnic area. Camping is permitted at the Teal Pond and Redbud Campgrounds. A nominal fee is charged.

Getting to Bell Smith Springs requires perseverence, but it's worth the effort. Drive south from Harrisburg on Route 145 and turn right (west) on Forest Route 402 at Delwood. After about six miles on this gravel road, turn left on Forest Route 447 and drive two more miles to the Bell Smith Springs entrance.

Emma's Ferne

Ferne Clyffe State Park is located one mile south of Goreville on Route 37, about 15 minutes from Marion. The most accessible of the three forest areas, Ferne Clyffe is also the most heavily used. More than 400,000 people visit the park each year, testimony to its natural beauty and excellent facilities.

Not far from the entrance to the park is the 16-acre Ferne Clyffe Lake, stocked with rainbow trout, largemouth bass, bluegill, channel catfish, and redear sunfish. Although the lake is not open to swimming or boating, a one-mile trail circles the lake, giving hikers and fishermen unlimited access.

The main attraction at Ferne Clyffe State Park, however, isn't fish. Meandering through the 1,100-acre park are ten hiking trails, about 15 miles worth. The quarter-mile Rebman Trail was named for Miss Emma Rebman, the schoolteacher who originally sold the land to the state. It is an easy trail leading directly to Hawk's Cave, a 150-foot long shelter bluff that hosts an intermittent waterfall. Ferns abound in this splendid woodland grotto set amidst some of the most impressive rock formations in Illinois.

Other trails explore the woods or command stunning vistas. The mile-long Round Bluff Nature Preserve Trail introduces hikers to some of the park's 700 species of plants, while the eight-mile Happy Hollow Horse Trail offers a little bit of everything plus a lot of exercise.

Ferne Clyffe has several campgrounds. At the class "A" Deer Ridge Campground there are modern shower facilities, picnic tables, and cooking grills. At the class "D" primitive campground called Turkey Ridge, grills are provided and drinking water is available at nearby parking lots. Other sites include a youth group campground, a backpackers campground, and an equestrian campground for those who bring their horses to the park.

Pack Your Bags

The Shawnee National Forest is open year-round, and every season in the forest has its natural wonders. Ferne Clyffe State Park, Bell Smith Springs, and LaRue-Pine Hills are only three of the many splendid places hidden away in the Shawnee, but they offer a representative sampling of what visitors to southern Illinois can hope to find there this fall. ■

Bill Furry is a regular contributor to ***The Nature of Illinois*** *and a staff writer for the Illinois Times in Springfield.*

Sandstone outcroppings appear in many areas of the Shawnee Hills. Where there is shade, thick carpets of mosses and lichens and an occasional gnarled red cedar or blackjack oak grow on what was once bare sandstone.

GIANT CITY

by Anne Mueller

Ruggedly beautiful, its landscape rises and falls and splits apart, telling a geologic tale 315 million years old. Ten thousand years ago, prehistoric tribes sought refuge under its rock overhangs as they took advantage of the area's seasonal food resources. Prior to the Civil War, settlers etched their names on its secluded sandstone walls. Fifty years ago, young workers chiseled a rustic retreat out of its own oak and stone.

Today Giant City State Park shares with its visitors a rich geologic and architectural heritage.

A Man-Made Retreat

Tucked into the Shawnee Hills of Southern Illinois, Giant City State Park seems far away from the frenetic world that typifies other parts of the state. Contributing to the serenity of its wooded 3,700 acres is a lodge constructed in the 1930s by a 150-member unit of the Civilian Conservation Corps (CCC). Refurbished by the Illinois Department of Conservation within the last few years and now on the National Register of Historic Places, the lodge is a tribute to the craftsmanship of the young men who hewed oak logs on site for beams and pillars and cut locally quarried sandstone for walls and archways.

Visitors taking one of two matching circular stairs to the lobby's arched mezzanine can feel the Corps' Rock-of-Gibraltar construction techniques. Massive timbers and stone, etched with marks of their crafters' tools, resemble those of medieval castles. The entrance doors, as well as the floors and all lintels, are constructed of solid white oak. Positioned around the towering fireplace is the original furniture the CCC crafted of local white oak and maple. A decades-old photograph near the hearth shows how little the lodge's interior has changed through the years.

The lodge at Giant City State Park, constructed by the CCC in the 1930s, is on the National Register of Historic Places. (Department of Conservation photo)

Adjoining the lobby and part of the original construction is a cocktail lounge. Its atmosphere is subdued today compared with the late 1930s when 15 cents would buy a beer and a nickel would start the victrola for revelers drawn inside by a red neon sign that spelled out "The Lodge—Chicken—Dine and Dance—Steaks."

People today still make special trips to enjoy the lodge's food, but now meals are served in a new dining room with seating for almost 200. As part of the construction undertaken in the 1980s, the dining room maintains the lodge's rough-hewn style. Also harking back to an earlier age—specifically, to prices set 10 years ago—is a family-style chicken dinner for $5.95 a person served every Sunday.

Overnight guests at Giant City have their choice of three types of cabins. The lodge's 12 one-room "historic" cabins have been rebuilt on their original foundations but, unlike their 1936 counterparts, are equipped with electricity and bathrooms. Eighteen recently constructed duplexes, called "prairie" cabins, feature a bedroom and a living room. Groups of six might opt for one of the four larger "bluff" cabins with fireplace, wet bar, and deck overlooking scenic woods.

Weekends are booked far in advance for all the lodge's cabins, but those seeking lodging during the middle of the week are more likely to find a vacancy. They might also have a chance to find themselves alone on a trail, to see the land as it was seen by the earliest of visitors. While visitors today consider the area visually intriguing, it probably was of interest to prehistoric people as well. They were likely drawn to the area because its geological and topographic variations supported diverse plant and animal resources.

The Prehistory of a Giant City

Nearly 300,000 years before the Wisconsin glaciers reshaped northern and east-central Illinois, other ice age glaciers advanced to the farthest southern point that continental glaciation would ever extend in North America. Occurring more than a quarter of a million years ago during a period known as Illinoian glaciation, these ice masses covered nearly 80 percent of Illinois but stopped just north of the area now known as Giant City.

The glaciers managed to leave their mark, however. As they melted away from southern Illinois 200,000 years ago or so, their meltwaters eroded the area's 315-million-year-old Pennsylvanian bedrock. Called Pounds Sandstone, it formed long ago when a succession of inland seas receded, exposing great expanses of sand from time to time. These ancient beaches later were inundated by encroaching seas, which also brought new sediments across the area to bury the old beaches. Pressure, caused by deep burial and mineralized groundwater that slowly flowed through the sand, solidified and cemented the sand grains together.

French's shooting star, among Illinois' rarest plants, is one of the park's small treasures.

The rectangular joint pattern evident in the Pounds Sandstone is the result of stresses within the earth, which also tilted the rocks slightly to the north and east. Water, which percolated downward through the joints and cracks, ultimately reached the bottom of the sandstone where it then eroded the underlying Drury Shale. Because the sandstone had been undermined by the water to some degree, and because the water had made the underlying shale slightly slick, rectangular blocks of the sandstone very slowly slid downslope toward a small tributary valley of Drury Creek. This produced the park's unusual rock formations, which to early settlers—it is reported—looked like the streets of a "giant city."

Prehistoric people had discovered the area long before, however. They found that another geologic feature—erosionally formed overhangs called rock shelters—gave them a measure of protection as they passed through the area. The land was forested as it is now, offering abundant game such as deer, rabbits, and squirrels. It also provided a variety of seasonal nuts, fruits, seeds, and roots.

An archeological survey conducted in 1978 by Southern Illinois University at Carbondale uncovered several artifacts, including fluted and unfluted projectile points and knives. Chert scrapers, grinding stones, and grooved pieces also presented the archeologists with evidence of Paleo-Indian activity from 10,000-7000 B.C. Later cultures dating from 7000-5000 B.C. left behind manos—hand stones used for grinding grains—and corresponding metates—stones with a concave upper surface used as the lower millstone. Evidence of tribes moving through the area from 5000-3000 B.C. was found in side-notched projectile points, straight-stemmed projectile points, and nutting stones.

No artifacts exist from 3000-500 B.C., but the archeological record picks up again around 400 B.C. Tool remains during this time and through A.D. 600 indicate hunting, woodworking, and the systematic quarrying of chert deposits. The closest source of chert-bearing limestone bedrock is near Cobden, eight miles from Giant City, so the people traveled or traded for it to chip it into weapons and tools. Because of the quarrying, some archeologists speculate people were occupying the Giant City area year-round beginning with this time period.

Many of the trails are rugged, owing to the park's terrain. (Ned Trovillion, photographer)

A stone fortification dating back to A.D. 600-900 also suggests year-round population by the Lewis culture. Some suspect they used the stone fort found in the park as a defense against the more technologically advanced Mississippian people. The fort is triangular in shape and two of its walls are 50-foot sandstone bluffs. The third wall, constructed of sandstone boulders, stretches for 265 feet and originally was about six feet high and nine feet wide at its base.

Hiking the "City's" Trails

Today the stone fort, the rock shelters, and the sheer-faced "giant city" walls are points of interest along the park's well-designed trail system. Six nature trails, ranging in length from a third of a mile to two miles, and a 16-mile backpack trail are mapped and detailed in self-guided interpretive trail brochures available at the park office. Most of the trails are rugged, owing to the park's terrain, but the Post Oak Nature Trail has a blacktop surface that can be maneuvered by most seniors, disabled visitors, and families with small children. Wooden paths along the route take hikers over a pond and intermittent streams. Prickly-pear cactus, rare in Southern Illinois, and the namesake post oak, handy for fence building, are two of the plant species visitors will see along the trail.

The crown jewel of the park's trail system is the Giant City Nature Trail. Only about a mile in length, the trail is rugged and in some places difficult to hike. But those who make the effort will see not only a large rock shelter used by ancient cultures, but also the towering bluff walls and street-like canyons that gave Giant City its name. Walking between them, hikers will note a temperature change reminiscent of a descent into grandma's cellar. They'll notice trees growing in unusual ways in an effort to set down roots and reach for sunlight. They'll also see the marks of numerous passers-by, who 150 years ago etched their names into the sandstone walls. Much of the chiseled graffiti is painstakingly precise, duplicating serif lettering found on public buildings and statues. Now some of the detail on the soaring walls is softened by velvetlike moss.

While the Giant City Nature Trail emphasizes the spectacular, there are many small beauties among the park's abundant plant life. Trillium Trail in the Fern Rocks Nature Preserve is home not only to various ferns from which it takes its name, but also to some rare plant species. Synandra mint, Forbes saxifrage, French's shooting star, and woodland bluegrass all bloom in the nature preserve, which for 20 years has served as a protected site for nature appreciation and study.

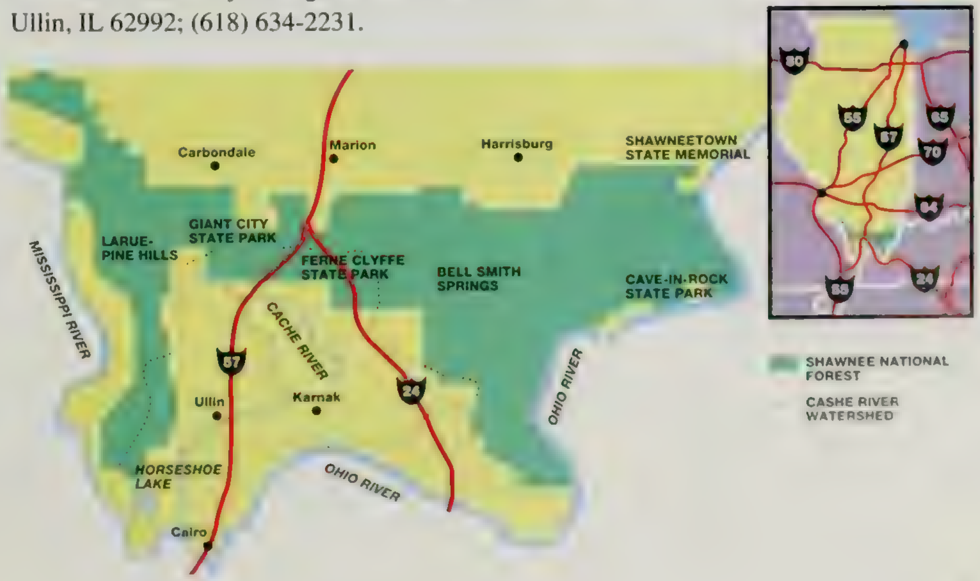
While the hiking trail system is the key to fully experiencing Giant City State Park, other attractions also draw people to the site. Lodge guests have access to an outdoor swimming pool. Fishing and seasonal hunting are available, and picnicking is accessible to disabled visitors. Horses are available at a concession-run stable, and twelve miles of rugged, timbered equestrian trails give horseback riders a close-up look at the park. Some visitors choose to take their horses into an equestrian campground overnight—it and other park campgrounds have electricity and water. Backpackers using the 16-mile Red Cedar Hiking Trail can elect to make the trip in one day, or set up a primitive camp overnight and catch their breakfast in one of the park's secluded ponds. The park presents a perfect backdrop for those looking for recreational variety amid striking beauty.

Giant City State Park and the geological, botanical, and cultural features it encompasses enables its visitors to see slices of time. Visitors to the park can look into and appreciate the past of Illinois, a past that otherwise might be confined to the pages of books. ■

Anne Mueller is a staff writer with the Illinois Department of Conservation. She is a former reporter who moved to the state from Wyoming, where she developed an interest in geology and archaeology. Background for the geological information in this article was supplied by David Reinertsen, senior staff geologist with the ISGS.

Mapping out the Sights

If you plan to head down to Southern Illinois you can call or write ahead for visitor information. For general tourism information, call the **Department of Commerce and Community Affairs** 1 (800) ABE-0121. For information on Illinois recreational sites and state parks, including Giant City Lodge, contact the **Department of Conservation**, Public Information, 524 S. Second Street, Springfield, IL 62701; (217) 782-7454. For detailed maps and information on the **Shawnee National Forest** contact the Forest Supervisor, 901 S. Commercial, Harrisburg, IL 62946; (618) 253-7114. If you want to learn more about the Cache River Wetlands write or call **The Nature Conservancy**, 79 W. Monroe, Chicago, IL 60603; (312) 346-8166 or the **Cypress Creek National Wildlife Refuge**, Shawnee Community College, Route 1, Box 53D, Ullin, IL 62992; (618) 634-2231.



Dean of the Ducks: Frank Bellrose

"Saving some land for the future, Frank, may be the most important thing we do." (1960)

Glen C. Sanderson
Illinois Natural History Survey
Principal Scientist Emeritus and Former
Head - Center for Wildlife Ecology

A prophetic statement. Twenty one hundred acres of swamp and marginal farmland were recently set aside on the Lower Cache River and dubbed the "Frank Bellrose Waterfowl Reserve." The Reserve will be developed and managed for wood duck nesting, migrating waterfowl, and wintering mallards by Ducks Unlimited and The Nature Conservancy with the cooperation of the National Fish and Wildlife Foundation, U.S. Fish and Wildlife Service, and Illinois Department of Conservation.

The dedication, which will be some time next year, honors the man who has spent his career at the Illinois Natural History Survey studying—primarily—waterfowl. Known as the dean of duck researchers, or Mr. Duck, Bellrose began studying wood ducks in 1938 and will soon publish his long-awaited book on the subject, based on more than 50 years of research.

Bellrose's work has led to a better understanding of the importance of wetland resources. Over the years (he "semi-retired" in 1982) Bellrose developed the first practical housing for nesting wood ducks, later improving the design to make it predator-proof; researched waterfowl habitat and food habits; counted waterfowl from such vantage points as boats, cars, trees, bluffs, and light aircraft; broke new ground in the understanding of waterfowl migrating patterns; studied the effects of season length, shooting hours, and the use of live decoys and baiting (banned in 1935) on waterfowl populations; and published a book, *Ducks, Geese, and Swans of North America* (1976). The book sold more than 250,000 copies, far more than is usual for a book of this kind. Bellrose, credited with close to 100 publications, is the recipient of an Honorary Doctor of Science Degree from Western Illinois University and has received numerous honors and awards, including the prestigious Wildlife Society Aldo Leopold Award in 1985.

But perhaps his farthest reaching achievement was his pioneering work with the problems of lead poisoning in waterfowl. His research at the Natural History Survey was a major factor in the gradual replacement of lead shot by steel. The total ban on lead shot for waterfowl hunting will be in full effect nationwide starting with the 1991-92 hunting season.

The Nature of Illinois Foundation Chairman Gaylord Donnelley, who has been a leader in conservation efforts in the Cache as well as other parts of the country, hosted a luncheon last year to begin fundraising for the Frank Bellrose Waterfowl Reserve. It was a fitting send-off. For it was Bellrose, along with Glen Sanderson, who first made Chairman Donnelley aware of the Natural History Survey when they met during their early work to save the prairie chicken from extinction.

Frank Bellrose

Donnelley was introduced to the two other Surveys in turn, and was so impressed by their work and so dismayed by their lack of recognition, that he agreed, in 1983, to serve as Chairman of a group of lay people who would act as friends of the Surveys. Donnelley is an active member of the Foundation (originally the Society for the Illinois Scientific Surveys) and is its chairman to this day. ■

Jean Gray, editor

Wood ducks (Courtesy Ducks Unlimited, Scott Nielsen photographer)

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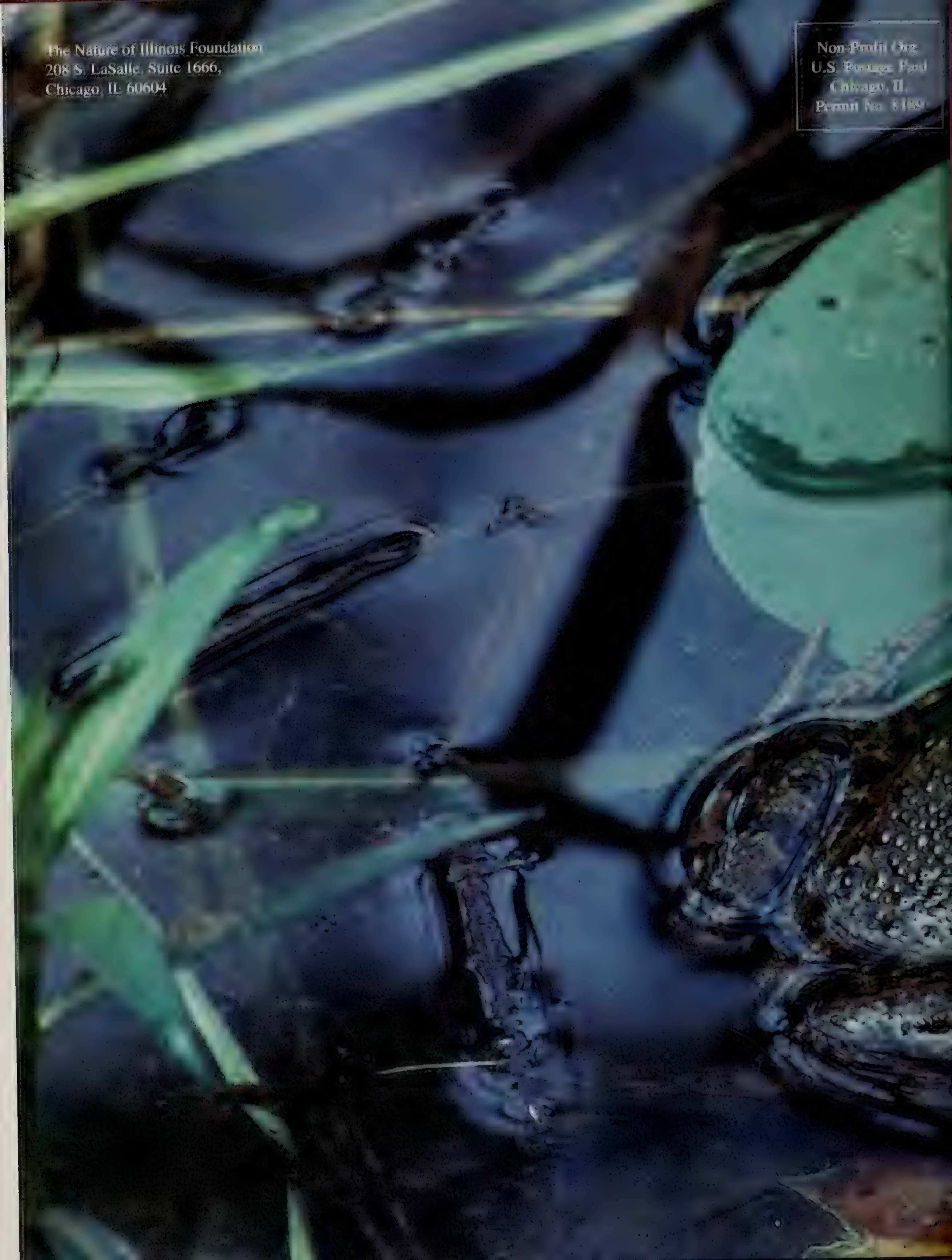

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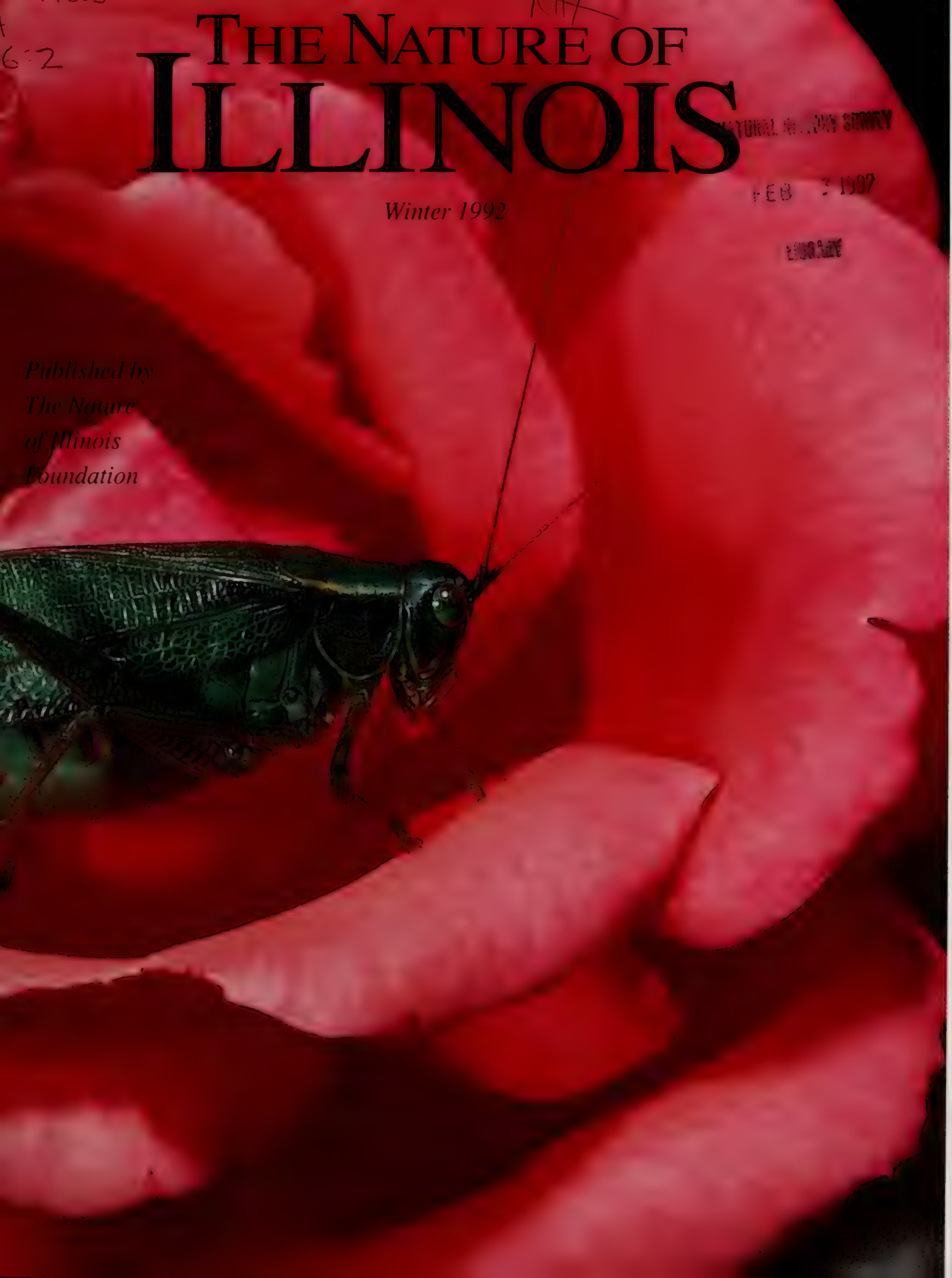

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Winter 1992 - Water Ways and Prairies

From the Foundation

If the word "survey" makes you think of roadside workers measuring for construction projects or intrusive phone calls auditing your buying habits, then please read on.

To me,"Survey" (with a capital S) means the Illinois Scientific Surveys (Natural History, Water, and Geological) and more than 150 years of cataloging Illinois' natural resources. Survey activities encompass hundreds of vital research projects; educational outreach; and technical assistance to private citizens, government, business, and industry.

Survey projects help protect our land, water, and air; our natural resources above and below the ground; our health; and the benefits we derive from our natural environment. Survey research helps ensure sound, safe economic development and helps state and local governments plan for future population growth—answering such complex questions as where to safely site landfills, municipal water supplies, and new construction.

Illinois is unique and fortunate among states in having three Surveys, under the Department of Energy and Natural Resources, that span the natural resources. The Hazardous Waste Research and Information Center, the most recent member of the team, assists the state and its citizens in the quest for a safer, cleaner, more productive future for Illinois.

It is the Foundation's mission, through the pages of this magazine and our other educational projects, to lead you to a greater appreciation for the state of Illinois and, even more important, to help you understand the important role that sound science plays in today's world.

Warmest Regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

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Cryptic katydid in a not-so-cryptic setting. See "Prairie Hide and Seek."

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Jean Gray *Editor*
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RIVER WATCH

The Surveys Look After Illinois' Aquatic Resources

by Ruth M. Sparks

At the confluence of the Illinois and Mississippi rivers at Grafton (Photo by Max Schnorf)

> *"My assistant and I were in an electrofishing boat, sampling the fish population in a small bay of the Illinois River just south of Peoria. Suddenly the water rushed away from the boat, laying it on its side with the propeller churning into the mud. As we scrambled to shut off the electric generator and the outboard motor, we saw 15 heavily loaded barges being pushed upstream past the mouth of the bay by a diesel-powered towboat. We just had time to observe mussels exposed on the bottom before the water returned in a series of waves that swung the boat around. At that moment, I began to wonder what effects increased barge traffic from the bigger locks at Alton was going to have on life in this river."*
>
> Dr. Richard E. Sparks, Aquatic Ecologist
> Illinois Natural History Survey
> River Research Laboratory at Havana and
> Supervisor of the Survey's LTRM stations.

A decade ago, the U.S. Army Corps of Engineers proposed replacing the old dam and single 600-foot lock at Alton, Illinois, with a new dam and two 1,200-foot locks. The proposal touched off an explosion of controversy that pitted such unlikely allies as the Sierra Club and the railroads against commercial navigation interests and the Corps.

From Confrontation to Compromise

Environmental groups feared the effects of increased commercial barge traffic on fish, wildlife, and aquatic vegetation. They felt the damage would be devastating for commercial and sport fishermen, mussel harvesters, and recreational hunters—those who depend on the natural resources of the river. Because no one could say with certainty how bad the effects would be, these groups proposed conducting environmental studies before construction began. Navigation interests, on the other hand, emphasized the positive economic impact that river traffic has on the entire midsection of the country; and they observed that, in spite of years of commercial traffic, it was still possible to catch fish in the river. The courts decided in favor of building the new locks and dam.

The debate, however, forced Congress to recognize that the Upper Mississippi River System is not only a barge canal, but also a biological treasure containing 132 species of fish; 50 species of mussels; and hundreds of species of birds, reptiles, and mammals, as well as the lesser known creatures that form the base of the food chain. The compromise Upper Mississippi River Management Act of 1986 authorized the dam, but it also established the Upper Mississippi River Environmental Management Program (EMP).

Canada goose nesting in a backwater slough on the Illinois River south of Peoria

Under this program, biologists and hydrologists began collecting the data they needed to answer some of the troubling questions that arose during the legal battles. The Illinois Scientific Surveys are involved with three EMP projects: long-term resource monitoring, habitat rehabilitation and enhancement projects, and monitoring physical changes associated with boat traffic.

Taking the Rivers' Vital Signs

The long-term resource monitoring (LTRM) program is a biological information-gathering project conducted from a network of six new field stations along the Illinois and Mississippi rivers. The Illinois Natural History Survey (INHS) operates the LaGrange station located at Havana, Illinois, along the Illinois River and the Pool 26 station located at West Alton, Missouri, just below the confluence of the Illinois and Mississippi rivers. Researchers collect information year-round on water quality, plants, and fish. Standardized methods of information-gathering make it possible to look at large-scale trends from upstream to downstream, from season to season, and from year to year.

In just three summers, John Nelson, INHS plant specialist at Pool 26, has documented dramatic year-to-year changes. His study area is just upstream of the lock and dam at Alton. During the 1988 and 1989 drought years, the dam was closed to keep water levels high enough to support commercial barge traffic. This kept his study areas flooded, and they supported a dense growth of American lotus. The spring of 1991, in contrast, was unusually wet, and it was necessary to keep the water flowing freely through the dam to prevent flooding upstream. Ironically, this resulted in many of the backwaters close to the dam becoming dry at a time of year when they would ordinarily have been flooded. The lush lotus beds were replaced by a dense stand of smartweed, an aggressive mud-flat invader that persisted even when the water finally rose in the plant beds later in the summer.

When Nelson compared his data with the fisheries data collected by his colleague Rob Maher, he noticed a close connection between the species of plants and the species of fish. The lotus beds of 1988 and 1989 had been inhabited by bass, crappies, and various types of sunfish; in 1991 the smartweed beds supported drum, gar, and carp.

Fluctuating water levels affect fish numbers as well. In 1990 water levels at LaGrange were above flood stage all year, covering islands and broad areas of floodplain forest and providing excellent spawning areas. In 1991 the spring flood lasted only until mid-June. When fish populations were concentrated in the main river once again, the success of the previous years' spawning became evident. Sampling nets containing hundreds of one- and two-year-old fish were commonplace.

Paul Raibley, an indomitable fisheries crew leader at LaGrange, recounted his dilemma when a severe thunderstorm blew in just as he had hauled in a hoop net containing more than 1,300 one-year-old channel cats. It was dangerous to stay and it was dangerous to go back, so he and his assistant, Barry Newman, just pulled the boat up against the bank and weighed, measured, and released every one of those fish while the storm raged on. "Our data sheets were soaked, and the boat was full of water," he said, "but we didn't lose a single fish."

Much of the nation's fuel and grain is shipped year round on the Illinois River. (INHS photo by Richard Sparks)

Impressive fish numbers make it tempting to jump to the conclusion that the river must be improving. In high water years, the concentration of pollutants is lower, but that could be due to an increase in the volume of water rather than a decrease in the amount of pollutants. It doesn't take a trained eye to see some of the water-quality problems. Flying over the two rivers near their confluence at Grafton, Illinois, it is easy to see where the muddy brown waters of the Illinois join the clearer waters of the Mississippi. The brown plume of Illinois River water hugs the eastern side of the river and is clearly visible miles downstream at the lock and dam at Alton.

"They are two distinct water masses," Eric Ratcliff said. "I know which river a water sample comes from just by the numbers I get." Ratcliff is the water-quality crew leader at the Pool 26 LTRM station. Year-round, rain or shine, he goes out to his sampling sites and tests the water for clarity, nutrients, dissolved materials, and oxygen. The readings from the secchi disk tell the clarity story.

A model of low-tech instrumentation, the secchi is a dinner-plate-sized disk painted black and white. When lowered into the water, the depth at which it can be seen indicates the clarity of the water. Ratcliff can drop his secchi disk off the side of his boat on the east side of the river and watch it disappear at a depth of only three inches. As he moves across the river and out of the plume of Illinois River water, visibility increases to two feet. It is the number of fine particles suspended in the water that makes the difference.

Using a slightly higher-tech instrument, called a conductivity meter, he measures how much electricity a water sample can conduct. The conductivity meter indicates the amount of dissolved solids the water is carrying. Whether from road salt or agricultural fertilizers, from sewer outfall or industrial waste, the numbers indicate that there is more there than can be seen with the naked eye. On most days the amount of dissolved materials flowing down the Illinois is twice the amount flowing down the Mississippi.

American lotus bed in late summer

Surveying the Rivers' Waves

The Illinois State Water Survey (ISWS) has the task of measuring the physical changes associated with traffic on the two rivers. When a fully-loaded 100-foot-wide by 1,100-foot-long barge-tow (as many as three barges abreast and five deep) moves on the river, some of its effects can be plainly seen. The water is pushed ahead, creating a huge bow wave in front of the barge; behind, a large "rooster-tail" is thrown up by the propellers; and along the sides there is a considerable drawdown of the water. When two of these behemoths pass each other, they set the river oscillating back and forth like waves in a bathtub—an effect that can continue up to 30 minutes. Such large vessels moving through the water can actually change the speed and direction of the flow of the river. Turbulence roils up the bottom sediments and re-suspends them in the water, and the waves contribute to bank erosion.

Measuring the Rivers' Mud

All these effects needed to be accurately measured, but much of the available equipment was not suitable for use on large rivers.

Undaunted, Dr. Nani Bhowmik, Director of the ISWS Office of Hydraulics and River Mechanics, and his colleagues adapted existing instruments and even designed and constructed new ones, testing them under rugged field conditions. In order to determine the effect traffic has on water direction and velocity, they set out 13 state-of-the-art velocity meters, placing them as close as they dared to the main channel without running the risk of their being run over. In order to accurately measure the waves and drawdown, the researchers designed and built their own wave gauges. Connected to computers on shore, the gauges measure velocity once every second and wave heights every tenth-of-a-second from sunrise to sunset. Battery-operated pumps collect water samples and measure the amount of suspended sediment. Back at their computers, the researchers analyze the data, assisted by a number of their colleagues, including a visiting mathematician, Bijoy Mazumder. When he left his office at the Indian Statistical Institute in Calcutta to collaborate with the Water Survey, Mazumder had no idea that he would be spending time in such intimate contact with Mississippi mud.

Mud is hardly a new problem. Even in the early steamboat days, shifting mudflats and sandbars threatened navigation. Accidents and groundings were commonplace. As human populations grew, however, major changes occurred in the way land and water resources were used. More and more of the drainage basin

Water Survey research site on the Illinois River near Kampsville. Instrumentation in the river measures velocity, sediment, and wave action. (ISWS photo by Nani Bhowmik)

was cleared for agriculture, leading to excessive soil erosion and increased sedimentation.

Beginning in 1913, with the completion of the hydroelectric dam on the Mississippi between Keokuk, Iowa, and Hamilton, Illinois, and continuing into the 1930s, 26 dams were constructed on the Mississippi River and five on the Illinois. They were hailed as a boon to commerce. Water behind the dams, sometimes as deep as 20 feet, backed up for miles upstream creating deep, safe passage for the ever-increasing river traffic. There was a temporary increase in aquatic habitat as backwaters became permanently flooded and floodplain lakes expanded. Fishing was great and populations of woodpeckers and warblers exploded as they moved in to take advantage of thousands of dead trees in the now-flooded forest.

The sediment was forgotten, but it wasn't gone. Year after year, inch by inch, the sediment was carried into the rivers and settled to the bottom, filling the newly created habitat. According to Dr. Bhowmik, the Illinois River Valley is silting in at a rate of from .8 inch to 2 inches of sediment each year. When he visited backwater lakes during the drought year of 1988, he found that many of them were essentially dry; and in normal years, some of them contain only a few inches of water.

Doug Blodgett, team leader at the LaGrange station, says "nobody cares about the first 14 feet of sediment when the water depth goes from 20 down to six féet deep. It's when the sediment gets to propeller depth that everyone gets excited."

Restoration and Conservation

Those last few feet of mud prompted habitat rehabilitation and enhancement projects. Near Peoria, for example, the East River used to be a flowing side channel, but it became plugged by dead trees that trapped so much mud that the channel is now a dead-end chute with mature trees growing on top of the plug. It will be restored to its pre-1965 condition by dredging, and it will be closely monitored before and after the work is done to assess the biological response.

A much-publicized project is the proposal to build islands in Peoria Lake using sediment dredged from the lake. The dredging would create deep areas for fish, and the islands would act as windbreaks, reducing wave action and turbidity. Perhaps, given clearer, calmer waters, the natural vegetation will reestablish itself. Chatauqua Lake, located along the Illinois River near Havana, has accumulated so much sediment that it is now only 18 inches deep. It is a candidate for restoration of habitat for fish and migrating waterfowl, as are Swan Lake and Stump Lake which are located on opposite sides of the lower Illinois River, just above the confluence with the Mississippi.

Gathering information about sediment, wave action, and water quality is the first step on the long road back to regaining what has been lost. Recommending practical ways to deal with some of the problems is the second step, and following up to see whether the treatment had the desired results is the third. Management practices need to be broad enough to include restoration of areas that have been destroyed as well as conservation of areas thus far preserved. The information gathered by the Surveys as part of the Environmental Management Program will help in guiding this restoration and evaluating its success. ■

Ruth M. Sparks is an environmental writer and educator who lives in western Illinois, between the two great rivers.

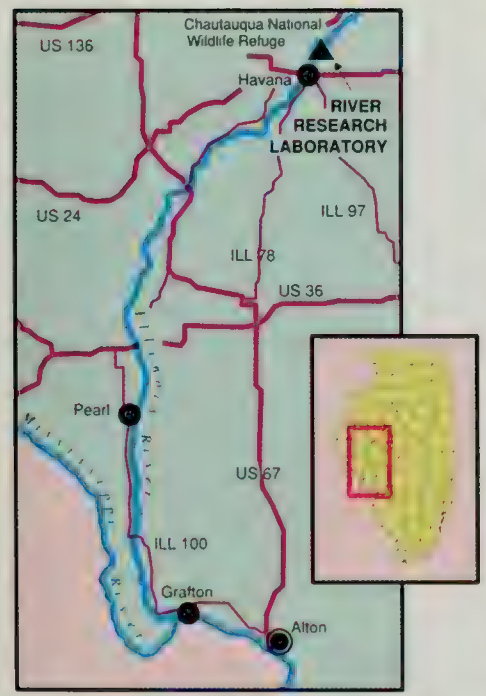
RIVER TOWNS

by William Furry

If the prairie is the heart of Illinois, the river is its soul. The tributaries of the state, especially the Illinois and Mississippi rivers, flow deeply through the cultural consciousness. Looking across the Mississippi floodplain at Cahokia, the largest prehistoric Native American city north of Mexico, one can appreciate the awe and reverence Native Indians felt as they gazed out across the "Father of Waters." At Dickson Mounds near Lewistown, one can experience a similar emotion looking out over the vast Illinois River bottoms.

Towns that sprang up along the Illinois' tributaries became the nerve centers of the state. Some prospered, others did not. Self-righteous Shawneetown on the banks of the Ohio River refused to loan money to a small community on the shores of Lake Michigan. Chicago survived, Shawneetown sank, literally. Kaskaskia, the state's first capital, disappeared forever beneath the muddy water of the Kaskaskia River. Other towns, such as Alton and Havana, thrived, developing economies that continued to grow long after the decline of commercial river transportation and the emergence of the railroads.

Downtown Havana



Map produced using the Illinois Geographic Information System. Map design by Katherine Hunter, Illinois Natural History Survey, 1991.

Small but Mighty

Three highways converge in Havana—routes 136, 78, and 97. A fourth, the Illinois River, is the town's westernmost boundary. The high ground, where the county courthouse sits, was once a favorite fishing spot for Native Americans, and legend has it that seventeenth-century French explorers Marquette and Joliet stopped at Havana for a fish fry. The Rockwell Indian Mound, believed to be a Mississippian burial mound, lies on Havana's northwest side and is now a shady community park. In 1858 it was a stopover point for U.S. Senate hopefuls Stephen A. Douglas and Abraham Lincoln, who took the opportunity to present their opinions on the expansion of slavery into the western territories.

Although small (population 3,800), Havana was once mighty. Commercial fishers in Havana at one time supplied freshwater fish to kitchens and restaurants in cities as far away as Boston and New York. There are still a few old-timers who recall the town's heyday, when sport fishers arrived in Havana by the trainload, and well-iced boxcars departed regularly with the day's catch on board. At the turn of the century, more than 2,000 commercial fishers worked the Illinois River from Hennepin to Grafton, harvesting annually nearly 25 million pounds of catfish, carp, buffalo, and bass.

In the mid-1950s, however, the heavily polluted Illinois River nearly died, and so did Havana. Industrial pollutants and raw sewage from northern cities washed downstream via the Chicago Sanitary and Ship Channel and virtually suffocated the river. Aquatic vegetation slowly disappeared from the once lush river, and freshwater organisms such as the fingernail clam, an important food source for both fish and birds, also vanished. Today, commercial fishers along the

Illinois River harvest fewer than two million pounds of fish per year.

Barging Down the River

Havana still relies on the Illinois River for its livelihood, but its emphasis is now more on shipping than fishing. The Illinois has always been a major transportation artery in the state, joining Lake Michigan to the Mississippi River, first by way of the Chicago portage, later by way of the Illinois and Michigan Canal. But recently the river has become even more economically vital due to rising transportation and energy costs.

According to Jim Whalen, manager of the ADM/Growmark elevator and shipping dock in Havana, a single grain barge can haul as much tonnage as 15 railroad boxcars or 60 semi-trailers, and it consumes only a fraction of the energy. ADM/Growmark ships 95-98% of the central Illinois grain it processes to New Orleans. "If you can catch a good ride," Whalen says, "you can get down to the Gulf in five to seven days." Normal shipping time, he says, is about 14 days.

Corn and soybeans travel downriver from Havana; coal is barged upriver where it will eventually be converted to energy at Commonwealth Edison power plants. And the traffic flows year-round. Unlike the wide, slow-moving waters of the Mississippi, the Illinois River rarely ices up even in the coldest of months. The river is narrow and the current strong at Havana, which keeps the shallow river channels open for traffic. On cold winter days in January, it isn't uncommon to see semi-trailers from Iowa and Missouri in Havana, backing up onto the ADM platform to send a load of grain to New Orleans.

Towboat operating on the Illinois River near Havana

Cell block remnant from the infamous Alton prison

Havana has other regional advantages, too. Mason County sits on top of one of west-central Illinois' largest natural resources: the Sankoty Sand aquifer. According to Adrian Visocky, Director of the Illinois State Water Survey's Ground-Water Resource Evaluation and Management Office, the Sankoty Sand—along with overlying sand and gravel glacial outwash—is a large sand and gravel aquifer, 100-150 feet thick. It is recharged directly by precipitation, Visocky says. The water table in the aquifer generally varies in depth from 10 to 50 feet and often is shallow enough that residents can water their lawns by sinking "sand points," small-diameter wells, and using suction-lift pumps.

The Sankoty Sand aquifer holds an abundance of fresh groundwater. Mason County irrigates more than any other county in the state, pumping a yearly average of 153,000 gallons per day per square mile from the aquifer, yet the Water Survey estimates the aquifer's potential yield is one and a half to three times that amount. Consequently, the fields in and around Havana produce abundantly. Havana is renowned for its watermelons, cantaloupe, and sweet corn, and local residents are equally proud of the local pickle factory.

There's uncommon natural beauty in Havana as well. Ten minutes from Main Street is the Chautauqua National Wildlife Refuge, a 4,500-acre natural habitat and recreation area managed by the Department of the Interior. Chatauqua is part of the Illinois River floodplains. For thousands of years the bottomlands have been a stopover on the Mississippi Flyway for geese and ducks migrating south. Waterfowl visited the region in such vast numbers, they often darkened the midday sky over northern Havana.

The Illinois Natural History Survey has maintained a field laboratory at Havana since 1894. (See *The Nature of Illinois*, Fall 1988.) The Survey's meticulous documentation of the flora and fauna of the floodplain has made the Illinois River one of the most studied ecosystems in the world. A comprehensive Survey study on lead poisoning in waterfowl was responsible for federal legislation prohibiting the use of lead shot for waterfowl hunting.

Originally a wetland, Lake Chatauqua was dammed, drained, and cultivated by Mason County farmers until 1936, when the land became part of the National Wildlife Refuge System. The farmland reverted to wetland, and the ducks and geese, after a long absence, returned to their feeding ground. The refuge is also a recreation area. Boating, fishing, and hunting (seasonally, and in specified areas) are permitted, as well as hiking, mushroom hunting, and berry picking. Visitors are encouraged to explore the grounds and look for waterfowl, songbirds, and other wildlife in this pristine, natural habitat. Hikers wandering the sandy lake shore should keep their binoculars close at hand to catch a glimpse of the splendid blue herons that frequent Lake Chatauqua.

City of Sinkholes

Illinois Route 100, the Great River Road, is undoubtedly the most scenic in the state. Beginning at Pearl in southern Pike County, the two-lane ribbon of asphalt parallels the Illinois River to its confluence with the Mississippi at Grafton, where it becomes a four-lane highway and continues on into Alton. The stretch of embowered highway from Pearl to Grafton is beautiful, especially in the fall, but the drive from Grafton into Alton is splendid. The road hugs the Mississippi River in the shadows of towering limestone bluffs. Bicyclists can also follow the River Road on the Sam Vadalabene Trail, a fourteen-mile stretch from Alton to Grafton.

The scenic bluffs along the eastern shore of the Mississippi River at Alton were created when the Cap au Gres fault system was exposed by river erosion. According to Leon Follmer, a quaternary geologist at the Illinois State Geological Survey, the bluffs above Alton are riddled with caverns and sinkholes. "Because the bedrock is limestone, it is soluble," Follmer says. "Rainwater mixing with soil acids seeps through the limestone and, over thousands of years, forms caverns." Sinkholes occur when the roof supports of a cavern collapse, creating large depressions in the land surface.

The drive into Alton from the east on Illinois Route 140 isn't as spectacular as the view afforded on the Great River Road. Nevertheless, it has its own drama. Within two miles of the Alton landing, the landscape begins to change radically. As one drives south on Alby Street, the narrow two-lane road ascends the first of several steep hills, which is quickly followed by a plummeting descent into a deep valley. Follmer says those characteristic peaks and valleys of Upper Alton's roads are actually old sinkholes. The roller coaster ride continues until the final hill is crested, and the entire Alton riverfront explodes into view.

If you see one, there are probably two or three others near by. The gregarious green-backed heron is commonly seen in groups along the Illinois River in summer.

The view from Alby Street hasn't changed much in 150 years. The old city hall, where Lincoln and Douglas held the last of their famous debates in 1858, is gone, but, thanks to a vigorous preservation association in Alton, the riverfront and several storefronts look much as they did in the last century. Alton's old downtown is an interesting mixture of antique stores, secondhand bookstores, service shops, vacant buildings, museums, and an information center. Down on the landing the riverboat *Alton Belle* is moored, an attractive reminder of Alton's historic ties to commerce, transportation, and now, recreation.

Alton was founded in 1818 by Colonel Rufus Easton, a St. Louis land speculator who later served as Missouri's attorney general. Easton platted the town and named it for his oldest son, but efforts to establish a commercial venture on the site ran aground when two Illinoisans, Nathaniel Pope and former territorial governor Ninian Edwards, decided they too wanted a piece of the riverfront. Easton eventually won the litigation, and, though he didn't live to see Alton incorporated as a city, his influence is still felt along the Alton river landing. In 1833 the shrewd Missouri lawyer decreed that the riverfront would forever be dedicated to the "commons," kept open to the people, and free from private development. To this day the Alton river landing remains public land.

When Alton was incorporated in 1837, the population was nearly 4,000. That same year, an outspoken newspaper publisher from Maine put Alton on the national map. Elijah P. Lovejoy, a thirty-five-year-old abolitionist from Albion, Maine, had settled first in St. Louis. But Missouri was a slave state, and when Lovejoy's anti-slavery editorials first appeared in the *Observer*, threats were made against his life. Fearing for his family's safety, Lovejoy moved with his

Grafton free ferry (ISGS photo by Joel Dexter)

wife and infant son across the river into Illinois, a free state in which, Lovejoy believed his anti-slavery views would be met with more tolerance.

They were not. On November 7, 1837, a large, pro-slavery mob attacked and set fire to the warehouse in which Lovejoy's printing press was kept. When the publisher refused to surrender to the rabble, the crowd opened fire; within minutes Lovejoy was dead and his printing press lay at the bottom of the river. Although charges were brought against the leaders of the mob, no man was ever convicted.

Alton was also the home of Illinois' first prison, a dreary, inhospitable facility with dirt floors and inadequate ventilation. In 1860 prison reformer Dorothea Dix successfully campaigned to have the Alton prison closed and the prisoners transferred to Joliet, but the Civil War created a need for a facility to house prisoners of war, and the Alton prison was reopened. The first boatload of prisoners arrived in February 1862. Soon after, a smallpox epidemic broke out, eventually killing between 1,000 and 5,000 Confederate prisoners. A cemetery atop the Alton bluffs commemorates those soldiers who died at Alton during the war.

Alton's early commercial interests were moored to the Mississippi. Steamers churned the water and charged the economy, and in the mid-1800s Alton became an important shipping center for rural communities north of the American Bottoms. The community grew so rapidly in the 1830s it was even considered a possible site for the new state capital.

But when the railroads came in 1848, Alton's moorings slipped, and the city founders' dreams for Alton becoming a major transportation center drifted down the Mississippi to St. Louis. Although Alton eventually recovered its losses by expanding the city's industrial base, the city no longer could look to the river for its livelihood, only for inspiration.

As one drives along the Great River Road, watching the sunlit ripples dance on the Father of Waters, it is not difficult to see how a little inspiration—and a lot of hard work—keeps the wheels churning in Alton and other river towns in Illinois. ■

William Furry is a regular contributor to ***The Nature of Illinois*** *and a staff writer for the* Illinois Times *in Springfield.*

The next issue of ***The Nature of Illinois*** *will explore the geology of Pere Marquette State Park near Grafton. For further information on the Alton area, write the Greater Alton/Twin Rivers Convention and Visitors Bureau, 200 Piasa Street, Alton, IL 62002; or call 1(800) ALTON IL. For information on the Chatauqua National Wildlife Refuge, write to the Refuge Manager, U.S. Fish & Wildlife Service, Havana, IL 62644, or call 1 (309) 535-2290. For general tourism information, call the Department of Commerce and Community Affairs: 1 (800) ABE-0121.*

SURVEYING GROUNDWATER

GEOGRAMS

Illinois State Geological Survey (ISGS)

Groundwater: Where Does It Come From? Where Does It Go?

Illinois has an abundance of fresh water. Besides streams and lakes, groundwater is a plentiful source of water, supplying drinking water for half of the state's residents and almost all of its rural residents. However, groundwater resources are not uniformly distributed, and they can be contaminated and/or depleted by careless, wasteful habits.

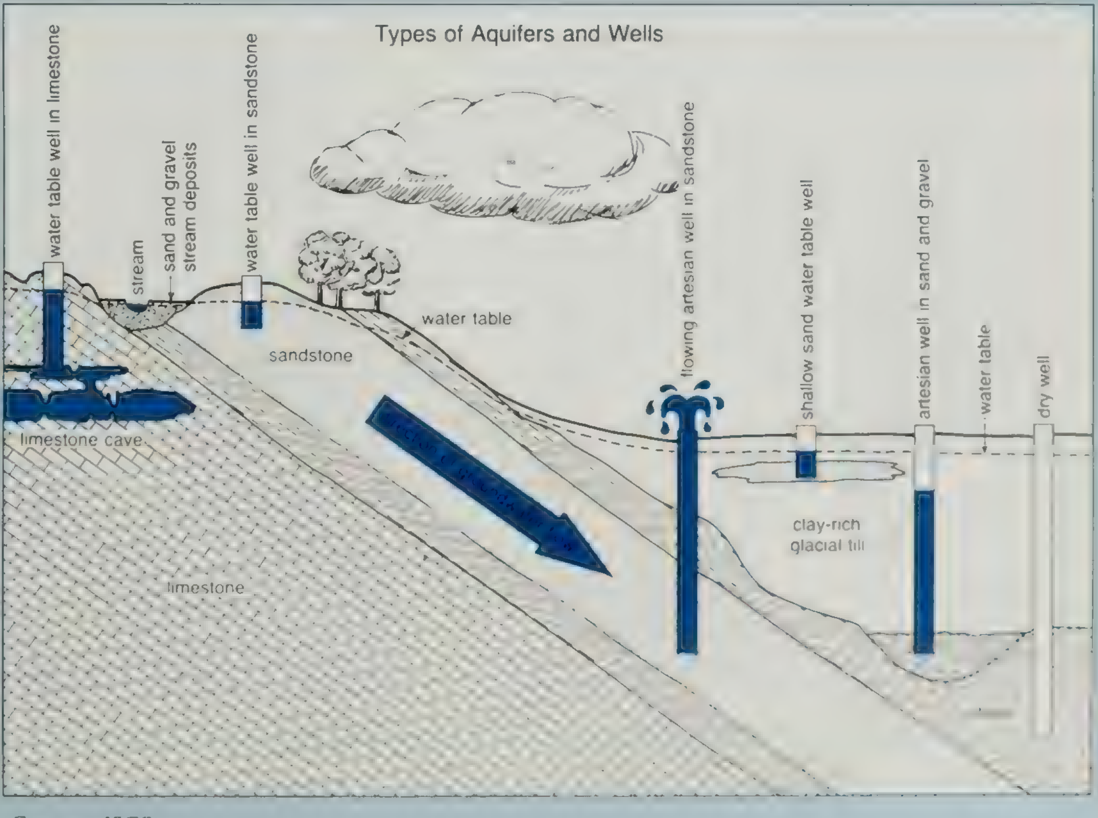
Groundwater is present in soil, sediment, or rock formations saturated with water. It is present in small, often microscopic, interconnected pore spaces between grains of sand and gravel and in open fractures in rock. The water level in a stream or shallow well marks the point in the adjacent soil or rock where groundwater begins and is called the water table.

Rain and melting snow infiltrate the soil and, if not used by plants, travel downward to the water table—migrating toward a stream, spring, or pumping well. Just as surface water moves from high to low elevations under the force of gravity, groundwater moves from high to low elevations through connected fractures or crevices and pores of rocks and sediments at rates that range from feet per day to only inches per hundreds of years. Thus, if seepage of water into soil is thought of as its birth, water from an aquifer may be days or thousands of years old.

An aquifer is a body of rock or sediment that will yield water of useable quantity to a well or spring. Clay-rich glacial till and shale that have low permeability and do not conduct water, act as confining beds and restrict the movement of groundwater. Thus, aquifers act as conduits bounded by less permeable materials. For example, the east-central Illinois' Mahomet Valley Aquifer, an ancient stream valley filled with sand and gravel is buried under glacial drift that ranges from ten to several hundred feet in thickness. Even though groundwater is moving through very small spaces between the sand and gravel, a well in the Mahomet Valley can pump millions of gallons of water per day. Such sand and gravel aquifers in Illinois produce 58% of the groundwater used; the remaining groundwater is produced from bedrock aquifers.

Recharge zones are areas between streams where surface water seeps into the water table. Groundwater moves from recharge zones to low-lying areas that serve as discharge zones (streams, springs, and lakes). Because aquifers are continually fed by precipitation and melting snow, the water table or the level of water in a well may fluctuate as a result of seasonal changes, droughts, and periods of heavy rain.

There are two main types of aquifers: the unconfined or water table aquifer and the confined aquifer. Unconfined aquifers, recharged through direct infiltration of rainwater, are found in counties with very


Types of Aquifers and Wells
water table well in limestone
stream
sand and gravel stream deposits
water table well in sandstone
flowing artesian well in sandstone
shallow sand water table well
artesian well in sand and gravel
water table
dry well
water table
sandstone
limestone cave
limestone
direction of groundwater flow
clay-rich glacial till

(Courtesy ISGS)

sandy soils (such as Mason, Kankakee, and Whiteside) where aquifers lie close to the surface. Confined aquifers are covered with relatively impermeable materials which impede infiltration into and out of the aquifer. Groundwater in a confined aquifer may build up so much pressure that, when intersected by a well, it will flow above ground in what is called a flowing artesian well. If the water level in a well is below ground surface but above the top of a confined aquifer, it is referred to as an artesian well.

The Hydrologic Cycle

Water present above, at, and below the surface of the earth is in continual movement. Rain, falling on a corn field, may infiltrate the ground, be taken up by plants and/or evaporated from both soil and plants, and returned to the atmosphere. Water that passes through the soil travels downward to the water table, where it becomes groundwater. The groundwater then migrates, assisted by gravity, toward a spring or stream that drains the land. Once discharged into a stream, the water begins its journey at the surface. In Illinois, surface water and groundwater ultimately flow to the Mississippi River and then to the Gulf of Mexico. During its journey and after joining the Gulf, water evaporates, eventually forming clouds...and the hydrologic cycle begins again.

ISGS Geologist Dennis McKenna records data from wells. (ISGS photo by Joel Dexter)

A Fragile Resource

Because aquifers are recharged at the surface, they are susceptible to contamination from anything (*e.g.*, oil, pesticides, sewage) spilled on the surface of the ground or buried beneath it. Water, other liquids, and solids placed on or in the soil migrate to an aquifer, a journey that may take hours, days, even years. Once an aquifer is contaminated, it is very difficult to clean up, and the process is usually prohibitively expensive.

Excerpted from a paper by
Samuel V. Panno
ISGS Groundwater Protection Section

Assessing the Risks

"Where groundwater resources are close to the surface, there is a high potential for contamination; where they are protected by thick, less permeable layers of glacial till, the potential for contamination is less. Our task is to provide reliable, scientific information to help the state evaluate that delicate balance between over- and under-protection, whether it's the use of agricultural chemicals, the siting of landfills and septic systems, or the disposal of industrial waste. Studies and maps developed by the two Surveys can identify and describe statewide hydrogeologic conditions that can be used by county extension offices, farmers, and government officials to understand groundwater conditions and make long-term plans."

Richard Berg studies an Aquifer Recharge map. (ISGS photo by Joel Dexter)

Richard C. Berg, ISGS
Head of Groundwater Protection Section

Geological Survey Paper Wins Award

Three Survey scientists, Richard C. Berg (ISGS), H. Allen Wehrmann (ISWS), and John M. Shafer (ISWS) co-authored a publication which received the John C. Frye Memorial Award in Environmental Geology at the Geological Society of America (GSA) national meeting in October 1991.

The award-winning document, "Geological and Hydrological Factors for Siting Hazardous or Low-level Radioactive Waste Disposal Facilities," was praised by Earl H. Bennett, chairman of the awards committee as "a land-mark effort that... will be used by many geologists throughout the country."

This 61-page report, published by the ISGS as Circular 546, presents a systematic approach to the selection and characterization of candidate sites and focuses on the potential for contamination of water resources by the disposal of hazardous and low-level radioactive wastes. Disposal sites require natural barriers to the migration of contaminants and must be stable, predictable, and capable of being geologically and hydrologically characterized.

The award was established by the Association of American State Geologists and the GSA to recognize Dr. Frye's substantial contributions to the understanding of environmental geology. Dr. Frye served as chief of the ISGS from 1954 to 1974 and, thereafter, as executive director of the GSA.

CURRENTS

Illinois State Water Survey (ISWS)

The Science of Groundwater Protection

The Illinois Groundwater Protection Act (IGPA), passed by the state legislature in 1987, establishes a comprehensive approach to groundwater protection that includes research, education, technical assistance, regulation, and evaluation.

However, according to John M. Shafer, Head of the Hydrology Division of the State Water Survey, "Having legislation that says we will protect our groundwater is a long way from the reality of protecting it."

In the last decade or so, according to Shafer, state environmental, health and welfare agencies, and the public have become increasingly concerned as more is learned about how vulnerable this precious natural resource is—and how susceptible it is to contamination. The Water Survey and the Geological Survey have been working together to help the state move toward the reality of scientifically sound groundwater protection.

ISGS Geologist Dennis McKenna collects water samples in the field. (ISGS photo by Joel Dexter)

"There's a good supply of groundwater for private and municipal wells in Illinois, but there is also a significant threat of contamination of that water supply," says Shafer. The problem, according to both Shafer and Richard C. Berg, Head of the State Geological Survey's Groundwater Protection Section, is to protect groundwater and at the same time keep the state's economy functioning and growing, to allow for expanding population needs and find safe ways to store the state's waste, and to strike a sensible balance between over- and under-use of fertilizers and pesticides.

If Any State Can Do the Job, Illinois Can

While many states have geological surveys to map and assess the hydrogeological factors that affect groundwater, Shafer is "not aware of any other state that has a water survey."

"We can do it all," says Shafer. "We have an enviable data base that goes back over a century. We have sophisticated data gathering capabilities—from our drill rigs to advanced instrumentation and state-of-the-art computer resources, including programs we've developed here at the Water Survey. We have a full array of laboratory facilities for chemical analyses. And, that aside, we have excellent scientists who are dedicated to understanding our groundwater resource and maximizing its value to Illinois."

John M. Shafer, Head of Hydrology Division of the State Water Survey

Shafer thinks the members of the general assembly would be surprised if they knew the breadth of what the Water Survey accomplishes with its state-allocated budget. "Our overall budget is at least two times greater than our state allocation because of the grants we receive and the research we do on contract. And the state and its citizens are direct beneficiaries of everything we do."

"Our programs at the Surveys combine a solid mix of applied observational science and theoretical research. This broad scope of effort is leading us to some answers about our groundwater and therein lies the ability to control and change things," Shafer says.

"The Surveys are the best bang for the buck as far as benefits for Illinois. I don't think that is really evident to most people."

Drilling for soil samples at pesticide research study site in southern Champaign County (ISGS photo by Joel Dexter)

Groundwater Projects – Short Takes

The Illinois State Geological Survey (ISGS) and Illinois State Water Survey (ISWS), both divisions of the Illinois Department of Energy and Natural Resources, are involved in a score of groundwater protection programs that include research, education, technical assistance, and evaluation. While the Surveys' functions are not regulatory, the results of their research provide scientific information and criteria for use by citizens, business and industry, and governmental agencies. Recent and current projects include:

- **Potential for Aquifer Recharge in Illinois (Map)** – The ISGS has developed a map which shows statewide patterns for the recharge of upper aquifers from rain and melting snow. (Recharge zones are areas between streams where surface water seeps into the soil and then into an aquifer.) Published in September 1990, the map is used by the Illinois Environmental Protection Agency (IEPA) to help identify priority groundwater protection regions.
- **Woodstock Needs Assessment** – ISGS and ISWS, in cooperation with the IEPA, have developed protocols and will develop a field manual to help communities protect water supplies. The depths and aerial distribution of aquifers within a 70-square-mile area around Woodstock were mapped, and researchers plotted the patterns and velocity of groundwater and contaminant flow through the aquifers to 167 private and municipal wells. Because Woodstock is a geologically complex region, this pilot study can serve as a model for a projected statewide assessment of groundwater recharge and for groundwater contamination potential in a wide variety of hydrogeologic settings.The study was funded by the Hazardous Waste Research Fund.
- **Rural Water Well Sampling** – The Surveys sampled private wells in rural areas of Illinois to evaluate the extent of agricultural chemical contamination. Samples were analyzed and the data entered into a computer system for use by the Illinois Department of Agriculture and Illinois Department of Public Health in a statewide survey of agricultural chemicals in groundwater.

Other Groundwater Protection Projects:

- ISGS field tests to determine whether groundwater is a major contributor to pesticide loading in Illinois streams;
- ISGS/ISWS field and laboratory studies to evaluate pesticide and fertilizer contamination of groundwater from agricultural sources; • Studies to determine the potential for groundwater contamination at agrichemical facilities where large quantities of pesticides and chemicals are stored;
- Methods for delineating safe areas around wellheads to prevent the contamination of water supplies by landfills, gas pumps, and other underground storage facilities; • Studies of synthetic/organic compound contamination from industrial uses in urban areas.

During the past year, the Surveys filled a total of 3,390 requests for groundwater information. The requests came from consulting engineers, individual citizens, federal and state agencies, industries, well contractors, municipalities, the media, universities, and realtors.

For detailed information about these and other Survey groundwater protection projects, contact the Public Information Offices at the Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820; or the Illinois State Geological Survey, 615 E. Peabody Drive, Champaign, IL 61820.

Special thanks to Richard C. Berg (ISGS), Samuel V. Panno (ISGS), and John M. Shafer (ISWS) for their assistance in preparing "Surveying Groundwater"; and to Suzanne Muckensturm, ISGS Public Liaison Office, and Laurie McCarthy Talkington, ISWS Publications Office, for their comments and review of the material. The Editor

HAZARDOUS WASTE: PAST, PRESENT, FUTURE

Illinois Scientists Try to Find and Cure the State's Hazardous Waste Problems

by William H. Allen

Kevin A. Cappo led a visitor down a hallway of the Hazardous Materials Laboratory, a brand new $9 million building filled with millions more in sophisticated analytical equipment. Cappo is safety officer and director of quality assurance and quality control at the lab, which houses the Illinois Hazardous Waste Research and Information Center (HWRIC) on the campus of the University of Illinois at Urbana-Champaign.

Looking through the wire mesh of reinforced glass windows, Cappo described three sample preparation labs—one for organic materials such as pesticides and oils, one for metal-contaminated samples, and a third "swing" lab for any overflow work. In one room, researchers were preparing samples of "red water" for analysis. The work was part of a federally funded study of the waste water produced in the manufacture of TNT.

"We're trying to find out what is in the waste water so we can treat it and make it less hazardous," Cappo said.

That, in a nutshell, describes the essence of HWRIC. The aim of the Center is to provide a coordinated, multidisciplinary approach to solving the state's massive hazardous waste problem. HWRIC is not a regulatory agency. Instead, it assists Illinois industry, government, and the public through research, information dissemination, and technical help. Its ultimate goal is to reduce environmental and health risks associated with generating and managing hazardous wastes.

Maze of large diameter Pyrex glass piping safely conducts potentially hazardous lab wastes to a series of sedimentation and holding tanks.

A History of Hazardous Waste

Illinois is a major generator of hazardous wastes, consistently ranking in the top three among all 50 states in the waste produced and disposed of by business and industry, said David L. Thomas, director of HWRIC since it was founded in 1984. In the most comprehensive survey to date, researchers established that 28.5 million tons of hazardous waste were generated in Illinois in 1986.

But the public and politicians alike had long before suspected a major problem. By the early 1980s, leaks at waste-burial sites in heavily industrial areas surrounding Chicago and St. Louis brought concern that Illinois might have a

Exterior of HWRIC entry at dusk

plethora of Love Canals hidden throughout the state, Thomas said. A wave of hazardous waste legislation that swept through the Illinois Legislature in 1983 and 1984 provided the initiative and money needed to establish HWRIC. The center was started by the Department of Energy and Natural Resources as a unit of the Illinois State Water Survey.

HWRIC operated out of several rented spaces in Champaign until its headquarters, the Hazardous Materials Laboratory, was dedicated in April 1990. Over the years, the Center's full-time staff has steadily grown to 30.

Reducing Waste at the Source

HWRIC's philosophy centers strongly on preventing pollution.

"The nation still has to look at ways of cleaning up contamination at the end of a process," Thomas said. "But early on, we realized that industry needs to create less waste, and when waste is created, it needs to be recycled in the industrial process."

Much of what needs to be done involves increasing the efficiency of industrial processes, which in turn increases productivity and profit. "We're not just talking about another environmental program like scrubbers," Thomas said. "When you—an industrial manager—invest in making your process equipment more efficient and stopping leaks, you do get a return on your investment, because you're using raw materials more efficiently. It makes a lot more sense from an industry point of view, and in terms of society and the environment."

The Center advocates voluntary change by industry in an atmosphere of cooperation among government, industry, and environmental groups. That in itself is a major shift from the traditional adversarial approach taken by these groups in the past.

"We need to develop more trust and change the way we think about environmental protection," Thomas said. "People agree that this makes sense, but it's a difficult process to integrate."

A Tour of the Hazardous Materials Laboratory

The 20,000-square-foot laboratory wing of the new Hazardous Materials Laboratory is an impressive mixture of high-technology and precaution.

In these labs sit $4 million worth of state-of-the-art analytical machines. A variety of chromotographs, mass spectrometers, and other devices pick apart the secrets in minute amounts of hazardous materials. This analysis is crucial to HWRIC programs that develop and test new waste reduction and treatment technologies, conduct a broad range of hazardous materials research, and evaluate contaminated samples with many components, such as those found in samples from an ongoing Great Lakes air-toxics monitoring project.

Safety is, of course, a major emphasis. Cylinders of gas needed to run equipment and perform analyses are stored in a storage bunker whose outside walls are designed to blow outward from the building in case of explosion. Eyewash stations and showers are positioned every 50 feet throughout the lab. A meticulously fine-tuned ventilation system keeps positive air pressure in the hallways and offices so that a leak of hazardous material—in the unlikely event that one ever occurs—is confined within the particular lab room. The system also continuously fills the lab area with fresh air, rather than recirculating part of the air, as in ordinary modern buildings. And special filters put the air back outside "in better shape than when it comes in," safety officer Cappo said.

Cappo moved through airlocks past the High Hazard Laboratory complex, a set of four labs with rigidly controlled temperature, humidity, and airflow. All the electrical fixtures are sealed to prevent hazardous chemicals from escaping outside the room. "Even though it's a hazardous materials lab, we work with such small amounts of materials and under such tightly controlled conditions that the most dangerous part of the day is driving to and from work," he said.

In one large room, the Pilot Laboratory, technicians were preparing to receive equipment from an Illinois electroplating company that was experimenting with ways to remove an oily substance from its plating bath solution. The company could reuse the solution—thus saving money—if it could learn how to remove the oily substance.

Company researchers had come up with a laboratory-scale reverse-osmosis process for filtering out the oily substance. It worked on a small scale in the company lab, but the firm did not have appropriate facilities for testing the waste-removal technology at the pilot-plant scale.

"If it works on this scale, then they will fit their plant with a large-scale system," Cappo said. "Instead of putting in $2 million to $4 million in improvements, not knowing whether it will work or not, this is an opportunity for them to try it out for a few thousand dollars." In return for use of the state facility, the company must permit the Center to distribute the technology if it is successful.

Continuing the tour, Cappo walked into the Glass Washing Room, a long, narrow room with sinks, glass-washing machines, and cabinets full of flasks, vials, and other glassware. A furnace along one wall heats glassware to 1,400 degrees Fahrenheit to burn off the smallest traces of organic material.

The atrium spine of the building admits natural light and allows views into high-hazard labs and the HWRIC library.

AGA
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Laboratory with computerized automated plasma analyzers for heavy-metals testing

The room looks unimpressive, but "it is probably the most important room in the facility," Cappo said. "Because we work with samples that have wastes at the parts-per-quadrillion level, or parts-per-trillion, or parts-per-billion, the glassware has to be impeccably clean."

The Focus on Research

The lab is used to conduct analytical work for studies by Center researchers and scientists with government, universities, and industry. "It has greatly expanded the support we can provide for research projects," HWRIC director Thomas said.

The Center itself sponsors a wide range of scientific research projects that seek to determine the extent of toxic contamination in the state's air, water, and land; the types of wastes produced, treated, or disposed of in Illinois; and the manner in which hazardous wastes move through and affect the environment. Other projects aim to discover better technology for reducing the amount of waste produced, cleaning up existing waste, and more safely disposing of waste over long periods of time.

HWRIC provides about $1 million a year in research grants to investigators at universities, industry, and government agencies. Some of these projects also get backing from federal grants.

Two particularly noteworthy research projects have focused on assisting in the search for cleanup solutions in two of the state's most contaminated areas: the Crab Orchard National Wildlife Refuge in Southern Illinois and Lake Calumet in southeast Chicago.

The soil and water of the Crab Orchard refuge are heavily contaminated with polychlorinated biphenyls (PCBs) and heavy metals from industrial activities that began in the region in 1940. A HWRIC-funded study started by scientists at Southern Illinois University-Carbondale in 1987 found high levels of contaminants in some fish species in Crab Orchard Lake—contradicting an earlier study that found no such contamination. The newer study caused state officials to issue an advisory against human consumption of large catfish and carp taken from the lake.

Studies sponsored by the Center are also examining contamination of water and sediments in the lake; contamination of insects, small mammals, and crayfish in the refuge; and concentrations of PCBs and trace metals in the air at several locations in the refuge. These studies will provide background information for comparison as remediation of several sites in the region proceeds under the federal Superfund program.

The Lake Calumet area near Lake Michigan has been the site of industrial and municipal waste disposal for more than a century. HWRIC has sponsored research aimed at assessing the risks to public health and the environment in the region and identifying steps needed to clean up the most threatening sources of contamination.

A pioneer study—and the first report of research funded by HWRIC—was "Industrial Wastes in the Calumet Area, 1869-1970: A Historical Geography," published in 1985. The study, by Craig

Colten of the Center and the Illinois State Museum in Springfield, documented the locations where industries in the region dumped their wastes. Colten also calculated the types and amounts of wastes. The study has served as an essential foundation for other studies in the region and has become a model for assembling historical profiles of current and abandoned waste sites in many areas of Illinois.

Striving for Waste Reduction

HWRIC's efforts to promote waste reduction and improve waste management were formalized in the Toxic Pollution Prevention Act, signed by former Governor James R. Thompson in 1989. Industry often resists pollution-prevention strategies, but the Center has developed a multifaceted approach to overcome what Thomas calls "industrial inertia."

The effort encourages waste reduction through annual Governor's Pollution Prevention Awards and matching funds for Recycling and Reduction Techniques. However, the keystone of the effort is the Center's Industrial and Technical Assistance (ITA) Program.

View into double-height treatability lab with "elephant trunk" fume exhauster

Center personnel with the ITA Program actively advise and assist companies in developing waste-reduction practices. They visit industry sites to evaluate waste-management practices and identify ways to improve them, emphasizing source reduction, recycling, and other methods for cutting the amount and toxicity of waste. They answer questions about hazardous waste regulations, conduct workshops on waste management, and provide contacts for more information and services from government agencies, vendors, consultants, labs, and waste handlers.

Since HWRIC is an information organization—not a regulatory agency—companies have nothing to fear in coming forward with questions about their waste problems, Thomas said. Once those questions are answered and a well-conceived plan is developed, companies committed to waste reduction can usually achieve their goals.

An Information Center

HWRIC's Library and Clearinghouse are the backbone of the Center's mandate to provide information to industry and the general public. Housed in a 1,600-square-foot area in the administrative wing of the new Hazardous Materials Laboratory, the rapidly expanding Library currently contains more than 2,000 books and government reports, 200 periodicals, and other sources on waste-related issues. Among its holdings are dozens of HWRIC research reports.

The Clearinghouse maintains booklets, pamphlets, and brochures on topics from asbestos to underground storage tanks. These are available free to the public. Since Earth Day 1990, HWRIC Librarian Sara R. Tompson has noticed a marked rise in requests for the material from county extension services, park district officials, and teachers from kindergarten to 12th grade.

"Industry has always been a strong user of our information services," Tompson said. "But the Center is going to be providing more service to educational institutions. Getting kids to think about the positive message of 'reduce, reuse, and recycle' is clearly the best long-term way to change things." ■

William H. Allen is a science writer with the St. Louis Post-Dispatch.

Photographs courtesy Holabird & Root, Architects, Engineers, and Laboratory Planners; Envirodyne Engineers David Clifton, photographer.

Pollution Prevention Benefits Bottom Line

Nine Illinois companies, educational institutions, and public organizations received top honors for their hazardous and solid waste reduction programs in the fifth annual Governor's Pollution Prevention Awards competition last fall. An additional 17 companies and groups were awarded certificates of merit. "The winners of these awards have exhibited a firm commitment to protect our environment," Governor Jim Edgar said, in presenting the awards.

Among those cited for outstanding achievements were Caterpillar, Inc., East Peoria; Illinois Power Company, Decatur; Chemical Industry Council of Illinois, Rosemont; Advanced Filtrations Systems, Inc., Champaign; Sun Chemical, Chicago and Kankakee; Nalco Chemical Company, Naperville; AGI Incorporated, Melrose Park; and Northwestern University, Evanston.

In additional to environmental benefits, pollution prevention programs bring substantial operating economies. Caterpillar alone saved nearly $700,000 last year as a result of company-wide pollution prevention activities.

Applications for the awards were reviewed by the Illinois Department of Energy and Natural Resources and the Illinois Environmental Protection Agency (IEPA) and approved by the Office of the Governor. The Hazardous Waste Research and Information Center works closely with Illinois industries to help them solve hazardous waste problems. The Illinois Toxic Pollution Prevention Act of 1989 established a statewide pollution prevention assistance programs at HWRIC and at the IEPA Office of Pollution.

Prairie Hide and Seek

by Susan L. Post and Michael Jeffords

A nymphal (baby) grasshopper hides from potential predators in a friendly flowerhead.

More than half of the living things on prairies are insects or their close relatives. The insects of the prairie are beautiful, useful, destructive, deadly, and endlessly strange and interesting. Yet on visiting a prairie one mostly notices the tall grasses and the showy forbs. An elusive prairie cicada may buzz in the distance, multitudes of tiny grasshoppers spring in front of every footstep, or an occasional swallowtail fly by, but where is the rest of the 50%?

Most are out of sight, either because they are exceedingly small, vanishingly rare, or hiding in any number of ingenious ways to avoid becoming the next meal for a hungry bird.

Two Rare Species

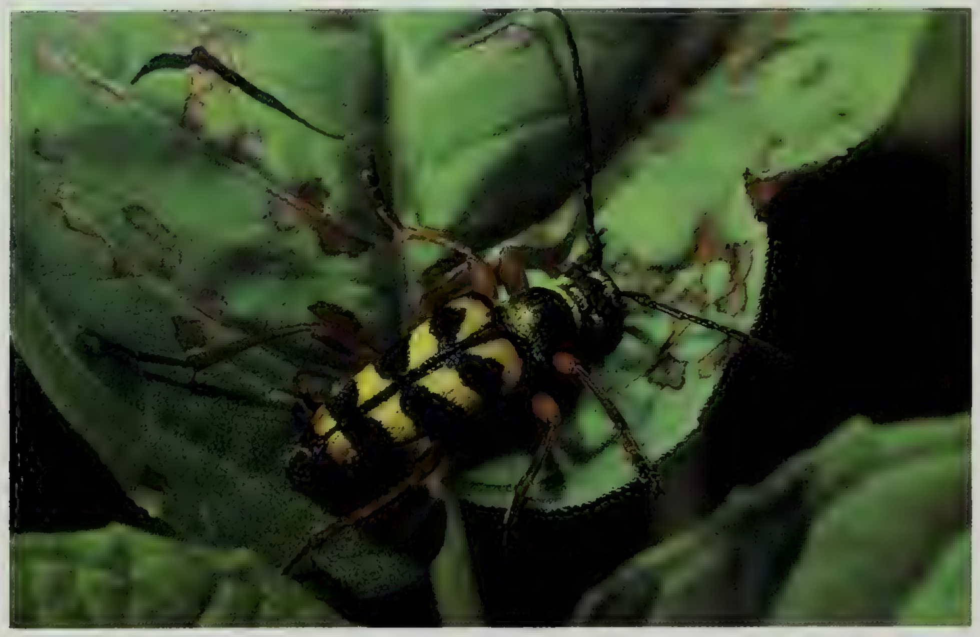
Although there are several rare insect species on the prairie, an owlet moth *(Papaipema eryngii)* and the Ohio emerald dragonfly *(Somatochlora hineana)* are two of the rarest insect species on Illinois prairies. The first, discovered in 1900, seldom flies, and then only at night and has never been sighted outside of Illinois. Its caterpillar feeds on rattlesnake master, a prairie wildflower, boring through the stem. A search of the Natural History Survey's insect collection revealed 24 adults and a single caterpillar, collected between 1915 and 1938 in the vicinity of Cicero by one Emil Beer. Subsequent attempts to collect the moth failed, and biologists assumed it was extinct, like most of the Illinois prairies (including the original collecting site). In 1989, two Illinois biologists, Ron Panzer of Northeastern Illinois University, and George Derkovitz, after a six-year search, finally collected the species at Goose Lake Prairie near Morris.

The Ohio emerald dragonfly was first described in Ohio in the 1930s. It is among the most endangered species of dragonflies in the United States and is now extirpated from Ohio. In 1983 a specimen was collected at Lockport Prairie Nature Preserve in Will County. Since 1990 the dragonfly has been found at five locations in the state, all located along the northern section of the Illinois and Michigan Canal Corridor.

While these two insects are certainly rare today, most likely because of habitat loss, conservation efforts may insure their continued existence. Other more common insects, however, must rely on their own devices to ensure survival in a dog-eat-dog world.

Batesian and Müllerian Mimicry

Insects of the prairie rely on various forms of deception to hide from predators, or, being predators themselves, to ambush victims; both processes increase their chances of survival and procreation. Deception can take many forms: mimicry, cryptic coloration, camouflage, or protective resemblance. As children the "classic" case of mimicry we learned in school was that of the monarch (*Danaus plexippus*) and viceroy (*Basilarchia archippus*) butterflies—insects that frequent prairies and open fields in spring and summer. The viceroy, a palatable bright orange butterfly, looks like the monarch, an unpalatable bright orange butterfly of no relation to the viceroy, so that birds that



The longhorn beetle, a clever mimic of the black-yellow striped pattern of the stinging bees and wasps, will most likely be avoided by predators.

have learned to avoid the distasteful monarch also avoid the tasty viceroy.

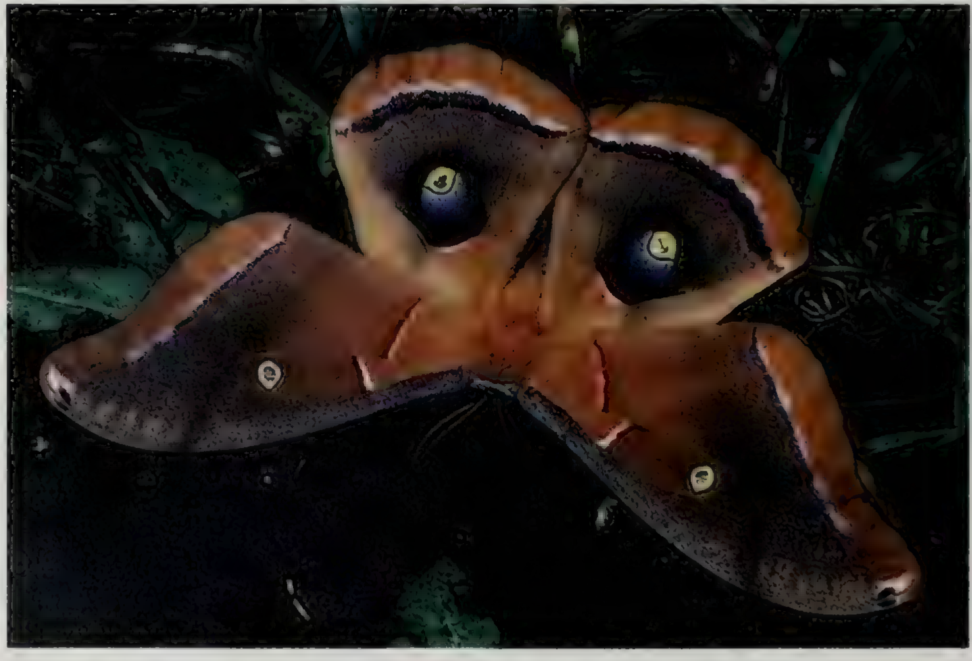
Monarch caterpillars, and subsequently the adults, are distasteful, even downright poisonous, because the caterpillars incorporate heart toxins into their chemistry. Called cardiac glycosides, these toxins are obtained from the milkweed plants the caterpillars eat. The striped pattern of the caterpillar and the orange color of the adult, called aposematic coloration, warn birds that both are to be avoided. If a young, naive bird happens to eat one, it is in for an unpleasant experience. Besides being poisonous, cardiac glycosides are also emetics, that is, they will cause the bird to vomit, not once, but several times. All in all, the bird is in for a bad time.

The above evidence has led entomologists to classify the viceroy as a Batesian mimic of the monarch. Named after the 19th-century English naturalist H.W. Bates who first noted the phenomenon in the Amazon, Batesian mimicry occurs when a palatable animal or plant "protects" itself from being eaten by resembling an unpalatable or toxic species. Recent studies in Florida, however, have shown that the viceroy-monarch story is not that simple.

Researchers found that the viceroy is just as unappetizing as the monarch and that the toxicity of an individual monarch depends on the kind of milkweed it ate as a caterpillar. While the viceroy feeds on nontoxic willows, it somehow manages to manufacture its own chemical defenses (poisons). Thus, the monarch and viceroy may actually be exhibiting another type of mimicry, called Müllerian. Fritz Müller, another European naturalist working in South America during the last century, documented this relationship. In Müllerian mimicry, two or more equally distasteful species gain greater protection from predators by having the same general appearance. The fewer color patterns a potential predator has to learn, the fewer "mistakes" it is likely to make. Such a scenario benefits both the predator and the prey.

Sheep in Wolf's Clothing

In Illinois, several other insect-mimicry complexes (groups of insects that resemble each other) occur and often involve insects that are totally unrelated. The black and yellow striped patterns on most of the stinging hymenoptera (bees and wasps) present an excellent, if confusing, example. These readily recognizable insects are generally avoided by many potential molesters, humans included, because they, and we, have learned to associate *black-yellow-black-yellow* with a painful experience (note that traffic-control agencies have appropriated this pattern for use in warning signs). Thus all stinging bees and



The Polyphemus moth spreads it wings, revealing a startling pair of owl-like eyespots—more than enough to deter even the most determined small predator.

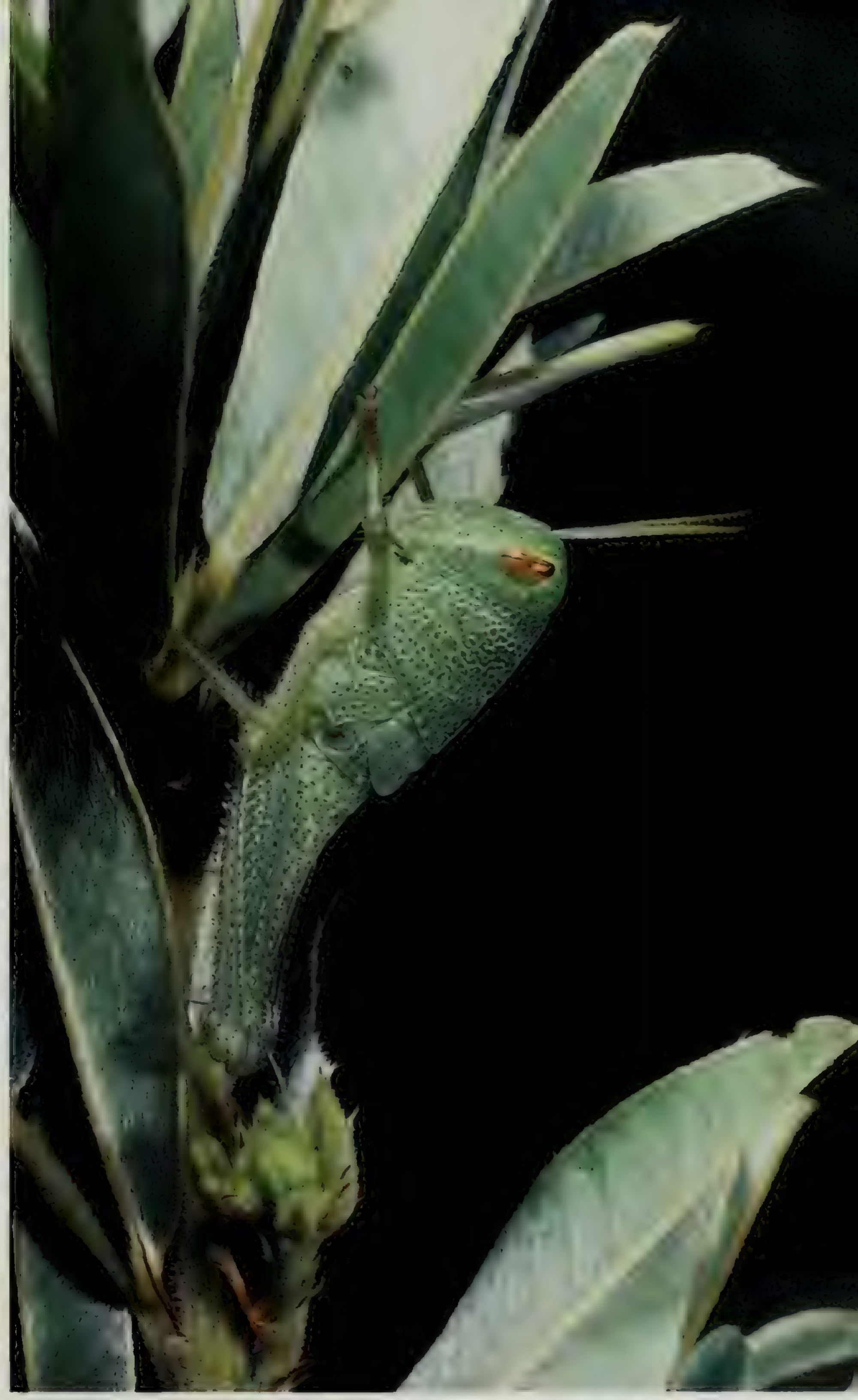
wasps that share this pattern are Müllerian mimics of each other (remember that Müllerian mimics are both noxious in some way and have similar color patterns). Many other insects, including flies, beetles, and moths, utilize this color pattern to good advantage and are astonishingly good Batesian mimics of bees and wasps (Batesian mimics resemble noxious insects but are themselves harmless). Some species are such clever mimics that textbooks, newspapers, and magazines regularly publish photographs labeled bee or wasp that are actually harmless flies, moths, or beetles.

The story, however, is not yet quite complete. As any entomologist knows, only female bees and wasps sting, yet both males and females share the same color pattern. Male bees and wasps, therefore, are not Müllerian mimics, but actually Batesian mimics of their own females!

Putting Food on the Table

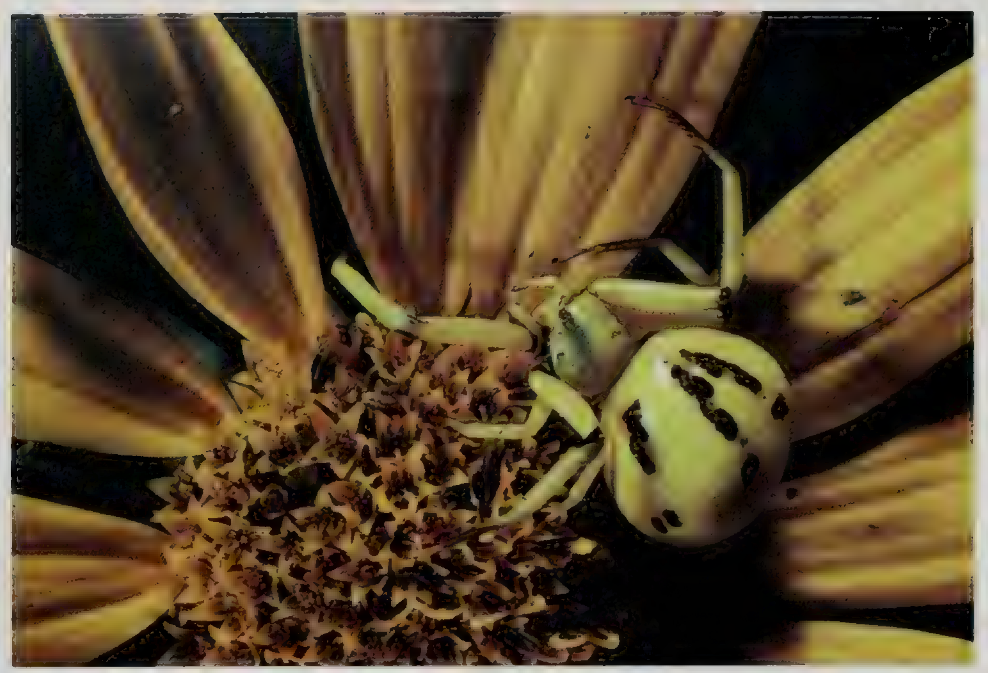
In a field of blazing stars, a wood nymph appears to be feeding as it sways with the plant blowing in the ever-present prairie winds—a sulphur butterfly rests quietly atop a thistle blossom. Upon approach, neither insect flies away. Are both so intent on their next meal as to be oblivious to the approaching danger?

Hardly, for closer inspection reveals that neither butterfly is feeding. Instead, both have become a meal for a tiny crab spider. Crab spiders of the genus *Misumena* are ambushers who earn their livelihood by skulduggery and deception. Usually found in the heads of flowers, the spiders sit motionless and wait for insects to arrive seeking pollen and nectar. A host of winged insects can then be seized and quickly dispatched with a potent venom. Size doesn't seem to matter much, and prey much larger than the spider—bees, wasps, and butterflies—are common victims.



A prairie grasshopper poses motionless and is hard to distinguish from the surrounding bush prairie clover leaves.

As if ambush weren't enough, the spiders also rely on camouflage. Crab spiders come in either yellow or white. While they may be found on a variety of different colored flowers, more than eighty percent 'hang out' on either white or yellow flowers. If a white crab spider happens to be on a yellow flower, it eventually changes color to blend in with that of its hunting ground. Crab spiders contain a pigment that is sensitive to white or yellow reflected light, and they change to match their background. The process may take a week or more, but it is revers



A crab spider sits motionless, unnoticed, waiting to dispatch its prey with potent venom.

ible. Being the same color as the flower station has two advantages for the spider; it helps in its hunting and also provides a measure of immunity from enemies. The latter strategy is called crypsis.

Rather frequently, though, crab spiders end up on flowers that they can't match in color. Does the spider go hungry? Not very often, for on flowers such as blazing star or thistle, the spider snuggles its brightly colored abdomen into the flower head and gives only a head-on appearance to approaching insects—deucedly clever, these spiders.

Keeping Body and Soul Together

A number of factors have acted together to influence the evolutionary development of insect design. Ecologists place insects in food webs as herbivores and primary and secondary consumers. Translated, this means that insects eat green plants and each other and, in turn, are eaten by a host of other organisms.

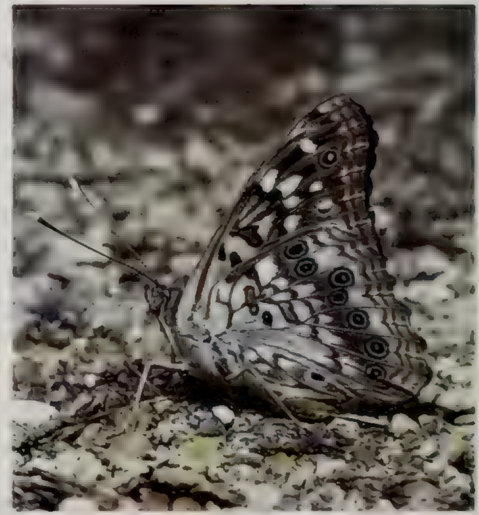
An insect has its skeleton on the outside of its body (called an exoskeleton), which means that it is, and has been for eons, subject to various modifications due to natural selection by predators. In simple terms, natural selection occurs when predators choose between various types of insects for their sustenance. An insect of a given species may have its exoskeleton modified in some manner by a genetic mutation so that it is less visible to a predator. Thus it may survive to reproduce while its more conspicuous sibling may not. Over time and through this process of natural selection, insects have developed some extraordinary methods to hide from their enemies (crypsis) or to appear to be something that they are not (protective resemblance).

The gaura moth (*Schinia florida*) has evolved a unique resemblance to its host plant, the morning honeysuckle. The bright pink-and-white moth sits on the flowers in such a fashion that wings and petals become indistinguishable. In fact, we have seen bumblebees land on moths and actually probe them with their tongues, thinking a shot of nectar was forthcoming.

The caterpillar of the gaura moth also gets into the act. A relative of the corn earworm, the caterpillar is green when feeding on leaves, but changes to a bright pink when nibbling on flowerheads. Equally impressive is the Polyphemus moth (*Antheraea polyphemus*). This giant silk moth rests with its hind wings folded together over its back, usually on vertical surfaces. When it is disturbed, as might occur when it is being eagerly sought as a meal by a hungry bird, a unique change in behavior takes place. The moth drops to the ground, spreads its wings out flat, and flutters its hind wings, revealing a large, startlingly realistic pair of owl-like eyespots—more than enough to deter even the most determined small predator.

The tenacity for survival of many species of insects is remarkable. The methods by which even the common species protect themselves from predators is even more remarkable and virtually limitless. It is enough to say that, being in their position on the Earth as major transferers of energy from green plants to higher organisms (they eat a lot and are eaten a lot), they are certainly not walking meekly to the slaughter. ■

Susan L. Post is an Assistant Research Biologist in the Center for Biodiversity at the Illinois Natural History Survey (INHS) and Michael Jeffords is an Associate Scientist in the Center for Economic Entomology and liaison for public relations and education at the INHS. Both are regular contributors to ***The Nature of Illinois****.*



The hackberry butterfly can depend on camouflage as long as it picks its backdrops carefully.

ILLINOIS PRAIRIE CEMETERIES:

Whispers From the Past

by Tara McClellan

The showy prairie puccoon blooms almost exclusively in prairie cemeteries.

> *"Every July I watch eagerly a certain country graveyard that I pass... It is extraordinary only in being triangular instead of square, and in harboring, within the sharp angle of its fence, a pin-point remnant of the native prairie on which the graveyard was established in the 1840s. Heretofore unreachable by scythe or mower, this yard-square relic... gives birth, each July, to a man-high stalk of compass plant or cutleaf Silphium, spangled with saucer-sized yellow blooms resembling sunflowers. It is the sole remnant of this plant along this highway, and perhaps the sole remnant in the western half of our country. What a thousand acres of Silphiums looked like when they tickled the bellies of the buffalo is a question never again to be answered, and perhaps not even asked."*
>
> (Leopold, A Sand County Almanac, Oxford University Press, 1949)

Most of us think of cemeteries as sad, colorless final resting places. But many are thriving homes for a rainbow of uncommon flora and fauna. Illinois has between 12,500 and 15,000 cemeteries, and slightly more than half of those are abandoned or despoiled, meaning they are no longer recognizable as cemeteries. Some have become unofficial bird sanctuaries or nature preserves because of their high quality prairie remnants. Those that retain even fragments of grave markers preserve precious moments of our history.

Slivers of a Forgotten Sea

Prairies once covered Illinois like a sea of waving grass. Now only slivers of that sea remain. According to Don McFall, Natural Areas Program Manager for the Illinois Department of Conservation, "There are two places in Illinois where you can find original prairie—along old railroads and in old cemeteries, because both were laid out before widespread land use."

These so-called "prairie cemeteries" were discovered in the mid-1970s during a two-year inventory of Illinois' natural areas conducted by the Department of Conservation (DOC) and the University of Illinois (U of I). Volunteers and botanists found 26 rural cemeteries with vegetation from prairies and savannas (the transition area between prairie and forest). They total nearly 50 acres of prairie. "To find original prairie in Illinois after 150 years of land use was a great find," McFall says.

Prairie cemeteries are usually small, between two and five acres in size. Illinois' settlers laid them out in the early to mid-1800s on unplowed land. (McFall says soil core samples show they have never been plowed.) The cemeteries started as family burial grounds on an unused portion of a farmer's pasture, typically in a scenic spot on a hill or ridge.

"It is ironic," says Michael Jeffords, Associate Entomologist with the Illinois State Natural History Survey (INHS), "that the settlers unwittingly preserved portions of what they were trying to conquer." Years later some of these cemeteries were abandoned, allowing the native vegetation free reign. "The settlers didn't have the time or energy to keep them up," Jeffords says.

Many of the old cemeteries are gone, according to McFall. They became overgrown, so farmers would plow and plant as much of them as possible.

DOC and U of I researchers found two types of prairie cemeteries, each reflecting different land uses and planning. One type is prairie intermixed with grave markers; the other is mostly prairie, located at the back of a small family cemetery. The settlers obviously planned for more burials than they actually had and the remaining prairie was left untouched. McFall says some people think the cemeteries should be mowed out of respect for those buried there. "But we think letting the native vegetation grow is a fitting tribute to the pioneers, a living memorial that reflects the land as they found it."

"A small cemetery can easily have 150 different plants, mostly wildflowers—like the shooting star, gentian, blazing star, purple and yellow coneflowers, and wood lily," McFall says. Some prairie cemeteries are havens for endangered species. For example, 21 rare prairie plants that were once found throughout Ford County are now restricted to the five acres of the county's Prospect Cemetery Prairie Nature Preserve. McFall says that while prairie grasses are dominant, the bounty of wildflowers transforms some of these old cemeteries into Monet-like landscapes. "Multiply a prairie cemetery by 1,000, and you can imagine what Illinois used to look like."

"From April until late frost, there is always something blooming," says Dwain Berggren, Associate Geologist at the Illinois State Geological Survey, describing the slightly more than three-acre Loda Cemetery Prairie in Iroquois County. He says there are several orchid species there, as well as wild petunia, white trout lily, blazing star, and about one hundred other species. Berggren is a Volunteer Steward and helps coordinate maintenance activities at Loda.

"In spring, it's a carpet of wildflowers," Jeffords says about the five-acre Weston Cemetery Prairie in McLean County. "This is a true mesic (medium-moist) tallgrass prairie. In wet years, the cemetery is surrounded on four sides by corn, and the prairie grasses are usually the same height as the corn."

Tomlinson Pioneer Cemetery Prairie in Champaign County has a different mood and is thought to be a savanna remnant, according to Jeffords. "It's up on a hill...the tombstones stick up through the wild hyacinth and shooting star like the glacial boulders that were dropped on the prairie there. Glacial boulders made the prairie difficult to plow; tombstones made it impossible."

The prairie white-fringed orchid was once locally abundant across the northern third of Illinois. Today it is on the state's threatened and endangered species list and occurs only rarely in prairie nature preserves, along railroad tracks, or in pioneer cemeteries.

Other wildlife populates these cemeteries, too. In summer, some of the cemeteries are prairie orchestra halls. At Loda, "there's a prairie cicada that you can hear as a low buzz in the grass," says Berggren. "It's a junior version of the ordinary cicada that appears in July." And there is "a host of katydid and cricket noises in both the summer and fall," he adds.

Berggren says Loda is also home to hosts of spiders, rabbits, small ground squirrels, a groundhog or two, and an occasional fox or coyote. Uncommon butterflies that seek out prairies, grasshopper sparrows, yellowthroats, and meadowlarks live there too, according to the *Directory of Illinois Nature Preserves* (McFall, Illinois Department of Conservation, 1991).

It is common knowledge among ornithologists and bird watchers that cemeteries are unofficial bird sanctuaries because, according to INHS Ornithologist Scott Robinson, they may be "the only areas around with greenery, especially in urban locations." He calls them "any port in a storm" for birds. The solitude, open areas, variety of trees, rich insect life, and varied plants make them natural places for birds to live and for people to watch them.

The prairie cicada, one of the largest and most colorful of Illinois' cicadas, can often be found resting on tall compass plants in prairie cemeteries in late summer.

Honoring the Past

Because cemeteries, like museums, contain a wealth of information about our ancestors, many people use them for genealogical studies. The Illinois Geographic Information System (GIS), operated by the Department of Energy and Natural Resources, can help by locating a particular cemetery close to the place a family member is known to have died.

The GIS's Geographic Names Information System database includes the name of every known cemetery in the state, its county and exact coordinates (longitude and latitude), and the United States Geological Survey quadrangle on which it appears. The database is in the public domain and the information is available, free-of-charge, says Warren Brigham, Director of the Center for Biogeographic Information for the INHS. The System's toll-free number can be accessed by computer, but Brigham prefers that new users, or people without computers, call him or GIS Specialist Mark Joselyn for help in using the system. The number is 217/333-8907.

Like the people they memorialize, cemeteries, too, are mortal. Without proper care, they can disintegrate and eventually disappear. Now that their historical, archeological, and botanical value is widely appreciated, laws have been enacted to try to ensure their survival.

One such law, part of the 1983 Illinois Natural Areas Preservation Act, gives the Illinois Nature Preserves Commission specific authority to dedicate cemeteries as nature preserves and permanently protect them from damage and destruction. "We felt the twenty-six prairie cemeteries (found during the DOC/U of I study) warranted special preservation," McFall says.

The Cemetery Care Act (CCA), administered by the Office of the Comptroller, stipulates penalties for disturbing graves in larger cemeteries and in those which provide perpetual care, according to Paula Cross, Senior Staff Archaeologist with the Illinois Historic Preservation Agency.

"We found, however," says Cross, "that few cemeteries fell under this category, since about half of all Illinois cemeteries are small family plots, church plots, and pioneer cemeteries. Because they, along with prehistoric cemeteries, were not protected by the CCA, the Human Grave Protection Act was written and signed into law in 1989. Penalties under this act include fines of up to $10,000 and three years imprisonment. The Illinois Historic Preservation Agency oversees this act.

While prairie cemeteries preserve botanical remnants from our past, grave markers preserve moments of our history. They let us glimpse fragments of our predecessors' personal lives. Cross tells about a hand-poured cement grave marker inscribed with a small boy's name and the dates of his birth and death. His marbles and other toys are imbedded in the marker. Cross guesses that the child's family was too poor to afford a proper grave marker so they made it themselves.

Not all grave markers are so poignant. Cross also tells about the inscription for a man who evidently had a serious illness for some time. His epitaph read: "I told you I was sick."

For information about nature preserve prairie cemeteries, write for the *Directory of Illinois Nature Preserves*, Illinois Department of Conservation, 524 South Second Street, Springfield, IL 62706, and include $3.00.

For additional materials, including suggestions for using local history in the classroom, write to the Illinois Heritage Association, Station A, Box C, Champaign, Illinois 61825. ■

Tara McClellan, a regular contributor to ***The Nature of Illinois****, is a free-lance journalist and arts reporter for Illinois Public Radio in Springfield*

Water Survey Chief Retires

"Research is the unraveling of nature's secrets."

Richard G. Semonin, Chief
The Illinois State Water Survey

Richard G. Semonin retired from the Illinois State Water Survey (ISWS) last November after more than 36 years. For the last five of those years he served as Survey Chief.

As he prepared for retirement, Chief Semonin recalled the 1897 writings of the Water Survey's first Chief, Arthur W. Palmer, who pondered the downward journey of the "water from the heavens" and the contamination it encountered along its path to Illinois' waterways and community water supplies. And, indeed, the analysis of precipitation has been the backbone of Water Survey research and service ever since the Survey was founded in 1895.

Although Chief Palmer recognized the importance of rainfall and its quality, it was only during Semonin's career that this recognition was fully implemented as a major Water Survey program. As the Survey grew and expanded to a staff of more than 200 chemists, meteorologists, and engineers, the study of "heavenly waters," Semonin notes, was combined with that of "limbo waters" (rivers, lakes, and streams) and "hellwaters" (groundwater).

A Reputation for Research

Semonin began his career at the Water Survey in 1955 as a young research assistant in meteorology, a program then in its infancy. He undertook some of the first atmospheric chemistry research in the United States, and his leadership in acid precipitation research is widely recognized.

In the mid-1970s, he was one of a group of researchers who established the National Atmospheric Deposition Program (NADP), the nationwide acid rain monitoring network. He was twice elected chairman of the NADP Site Criteria and Standards Committee and led the effort through which the Water Survey was selected to operate the program's Central Analytical Laboratory, which now processes weekly precipitation samples from 200 monitoring stations in the United States, Canada, American Samoa, and Puerto Rico.

Richard G. Semonin

Over the years, Semonin has seen the Water Survey develop a national and international reputation for research. No other state has such an irreplaceable scientific resource as the Water Survey, with its ability to provide data, conduct research, and solve problems.

Survey Chief

Many of Illinois' unresolved problems have been the subject of research during Semonin's tenure: gradual loss of lake and streamwater resources to sedimentation, the potential degrading of groundwater quality, the ever-changing weather and climate stress on Illinois agriculture and other sectors of the economy, and flooding in both urban areas and along rivers and streams.

"As the people uncover new concerns about their water and atmospheric resources, the Water Survey is ready to tackle them," Semonin said. "Few environmental concerns today rank higher than the availability of pure water to ensure the health of the people, as well as recreation, transportation, and a strong industrial and agricultural economy."

One of the Chief's major accomplishments was the reorganization of the Survey to meet future state needs as they arise. The agency's new flexibility will permit research and service capabilities to be shifted rapidly to respond to top priority issues and make maximum use of available state tax resources.

Semonin credits unlimited research challenges for keeping him at the Survey for 36 years. In his retirement he looks forward to other kinds of challenges: fishing, golf, time with the family (including nine grandchildren), travel, work on family genealogy, and continuing research and writing on weather and climate and their impacts on the Civil War. He also plans to work on an "unofficial" history of the Water Survey for its 100-year anniversary in 1995. ■

Thomas E. Rice, ISWS

The ISWS publication, "The Illinois River: Working for Our State," sets forth the serious problems that face the Illinois River and outlines possible solutions. A limited number of copies of this ambitious research effort are available to Foundation members. Those with a serious interest in the subject can request a copy from The Nature of Illinois Foundation, 208 S. LaSalle St., Suite 1666, Chicago, IL 60604.

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THE NATURE OF ILLINOIS

Spring/Summer 1992

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THE NATURE OF ILLINOIS

Spring/Summer 1992 – A Mission to Inform

From the Foundation

This issue of The Nature of Illinois magazine is fondly dedicated to the memory of Mr. Gaylord Donnelley, who founded The Nature of Illinois Foundation in 1983, guided its growth and development, and served as its chairman until his death in April of this year. We recount some of our memories of him in an article on page 9. In the meantime, we carry on with the work he cared so much about: the support of "sound science in service of the environment and the economy"—and print here the column prepared before his death. Jean Gray, Editor

There is more than one way to create an educational exhibit, and The Nature of Illinois Foundation has recently collaborated on two quite different approaches to this challenge: one, a shoestring enterprise, built in the Natural History Survey's workshop, the other, a high-tech exhibit, designed and built by museum experts. Both approaches—described in this issue—appear to work well, and both projects help us fulfill one of our prime missions: to educate adults and children about the role of science in the conservation of our precious natural heritage.

It is our goal, through the pages of this magazine and through our educational projects, to keep you learning about science—and about Illinois. The last issue of *The Nature of Illinois* covered Survey projects that monitor Illinois waterways and protect groundwater resources; next fall our attention will turn to geological matters. Through the articles in *this issue*, you can add to your store of knowledge of the flora and fauna of Illinois; read about some of the research projects of the Scientific Surveys and Hazardous Waste Research and Information Center (HWRIC), so important to our health, our natural resources, and the economy; and learn about public service programs and educational materials that are available to you through these state agencies.

We hope you will help support our efforts, and the efforts of the Surveys and HWRIC, by becoming a member of The Foundation if you have not already done so.

Warmest Regards,

Gaylord Donnelley

Gaylord Donnelley
Chairman, Board of Directors

written April 15, 1992

The Nature of Illinois is published by The Nature of Illinois Foundation in support of the Illinois Scientific Surveys (Natural History, Water, and Geology) and the Hazardous Waste Research and Information Center. These four agencies span the state's natural resources and have a 150-year history of data collection, research, and service. Their activities encompass hundreds of vital research projects; educational outreach; and technical assistance to private citizens, government, business, and industry.

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Diminutive mushrooms are found growing in clumps on decaying deciduous logs in prairie groves.

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Editorial Staff
Jean Gray *Editor*
Michael Jeffords *Photographer*

Design
Mobium Corporation, Chicago

Stay In Touch
Name and address changes and membership information should be sent to The Nature of Illinois Foundation, 208 S. LaSalle, Suite1666, Chicago, IL 60604, (312) 201-0650. Master Card and Visa accepted.

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FOREST ON THE PRAIRIE

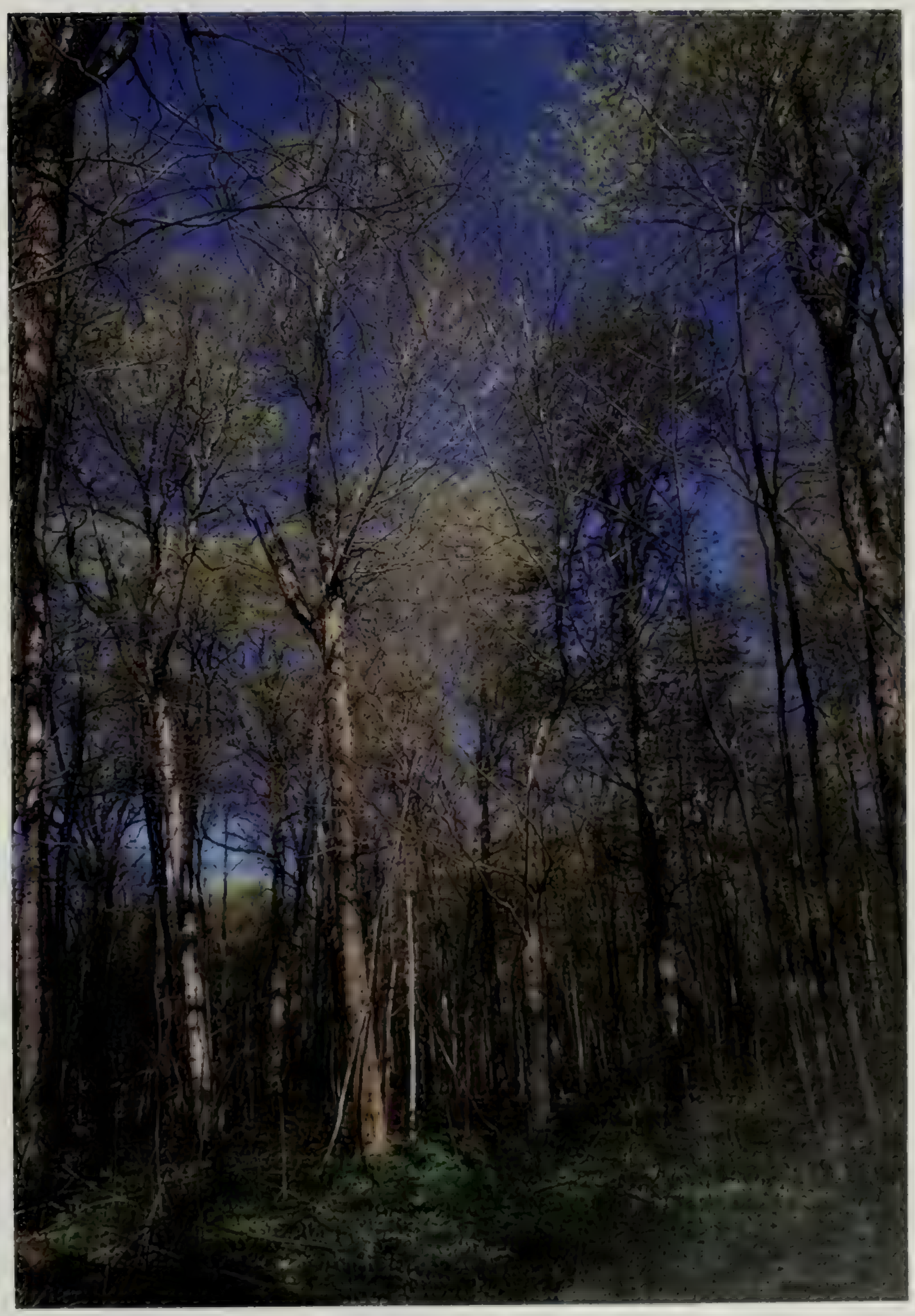
by Susan L. Post and Michael R. Jeffords

> *"Sometimes the woodland extends along this river for miles continuously, again it stretches in a wide belt off into the country, marking the course of some tributary streams and sometimes in vast groves of several miles in extent, standing alone, like islands in the wilderness of grass and flowers."*
>
> U.S. Government Geologist Owen, 1830

When Europeans began to settle the Illinois country, what is now central and northern Illinois was largely prairie, interrupted by forests only on floodplains, on slopes bordering streams, in river beds, and in isolated prairie groves. Many of these groves were completely surrounded by prairie, and often they were separated by many miles. They were important to Native Americans as landmarks and campsites. The first white settlers chose to live in these groves rather than on the open prairie because they were often near water, offered protection from harsh weather, and provided wood for building materials and fuel. In addition, prairie groves provided a link with familiar terrain. These early settlers were forest people, unaccustomed to-and uncomfortable in-a vast expanse of grassland. Today, these groves are surrounded by farmsteads and cultivated fields. Their original sizes and shapes have been altered by logging, grazing, and other human activities, but they still exist as biological islands in the agricultural landscape.

A Palette of Wildflowers

The typical prairie grove consists of oak-hickory and maple-basswood forest types that support an undergrowth of redbud, pawpaw, prickly ash, and sassafras. The herbaceous vegetation often includes



Trelease Woods in early spring. It is one of two 60-acre sites maintained for research purposes by the Department of Ecology, Ethology, and Evolution at the University of Illinois.

Life starts early in spring as many kinds of seedlings push up through the carpet of leaf litter in prairie groves. It is important for ground plants to make headway while the sun shines because, as spring turns into summer, the understory becomes shaded by a dense canopy of trees.

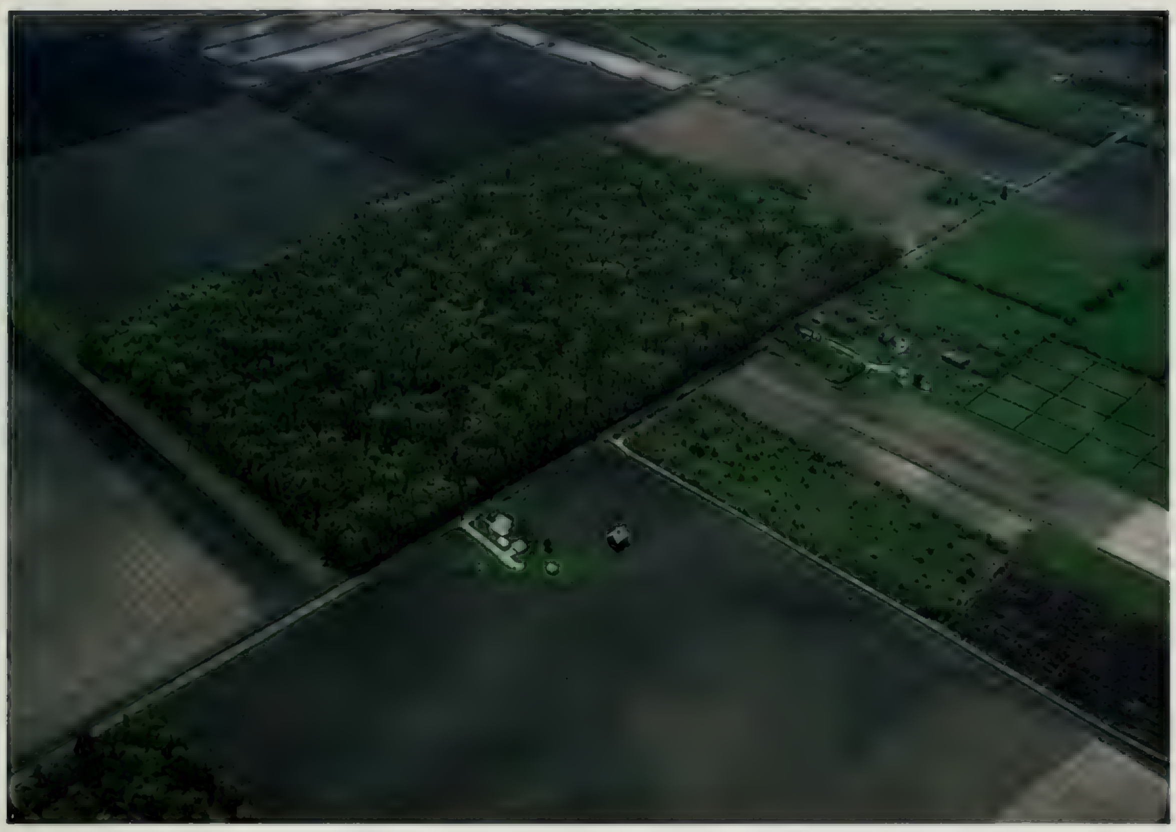
spectacular assemblages of wildflowers. Beginning as early as March, the floor of the prairie grove is carpeted with wave after wave of showy wildflowers—several species of trillium, Dutchman's breeches, Virginia bluebells, and mayapples, to name only a few. Climax forest herbs, such as snow trillium, hepatica, and bloodroot, peak very early each spring. As summer approaches, the canopy closes, and the woods become dark. The spring ephemerals—plants that grow, flower, and disappear in a short time—are replaced by thick patches of stinging nettle, bedstraw, and poison ivy. By late summer, only the uncommon trumpet honeysuckle and abundant jewelweed bloom in the dense shade.

In the Beginning

Superficially, prairie groves are easy to explain. Along streams and rivers, trees were better able to compete with the prairie vegetation because of the increased moisture. The isolated groves were composed of species that had invaded from other forested areas and gained a foothold in the moist prairie sod. Origins are not often obvious, however, and the beginning of prairie groves is no exception.

To understand the true origins of prairie groves, we must return to the period immediately following the melting of the last glacier in Illinois. The fossil record of pollen from prehistoric plants tells us that about 15,000 years ago, as the Wisconsin glacier receded, the northern half of Illinois was covered with a northern-type forest—an immense dark roof of spruce and pines. About 12,000 years ago, large areas of this forest were replaced by a rich, mature deciduous forest of maple, ash, elm, birch, and alder. This forest persisted

Mourning cloak butterflies, known in England as Camberwell beauties, overwinter as adults in protected sites such as prairie groves. It is the first butterfly seen each spring.



Trelease Woods from the air. Like many other prairie groves, its square shape might lead an uninformed observer to conclude that the site was planted. In reality, its shape was carved out along township section lines by logging and grazing, the building of farmsteads, and the planting of cultivated fields.

for only about 1,000 years. When the climate became warmer and drier, the moist forests began to be replaced by oak and hickory, species better adapted to such conditions. About 9,000 years ago, major climatic changes occurred, resulting in what is called the Hypsithermal Interval, a period characterized by very warm temperatures and little rainfall. Within a comparatively short time, perhaps 500-800 years, the oak-hickory forest largely gave way to the kind of vegetation we now call prairie. These plants were tolerant of increased aridity, regularly occurring droughts, and massive periodic fires. The only trees that survived the Hypsithermal Interval were those protected from fire. During the past 1,000 years, the climate in Illinois has become slightly cooler and more moist, once again creating conditions more favorable for the growth of trees.

Could Smokey the Bear Be Wrong?

The formation of certain types of prairie groves and savannas, a habitat consisting of widely spaced, broad-canopied oak trees with prairie grasses and forbs growing beneath them, is closely tied to the interaction of fire and topography. In the early prairie landscape of Illinois, prairie groves and savannas were most often found on the east side of streams and marshes, features that acted as firebreaks, or on the eastern slopes of hilly uplands. Prevailing winds pushed prairie fires in an easterly direction and, because fires burn with greater intensity going uphill than downhill, the eastern hill slopes were somewhat protected. Fire-resistant trees, such as thick-barked oaks, persisted on these downhill eastern slopes.

The result was a savanna. In 1830, the savanna was an abundant habitat type in northeastern and central Illinois. Savannas usually occurred on rolling uplands, while prairies dominated the flat-to-gently-sloping lowlands. Evidence for this mechanism of savanna formation exists in the soil and in the three species found on savannas. The soil is typically forest-type rather than prairie soil, and black and burr oaks, both highly fire-resistant species, are dominant.

Around 1860, when settlers had converted much of the virgin prairie in Illinois to farmland, the prairie fires ceased. On many savannas, trees that were less fire-resistant sprouted, filled the gaps between the widely spaced oaks, and shaded out the prairie plants.

Morels, the subject of intense early spring searches by mushroom fanciers, appreciate the relatively undisturbed woodland environment of prairie groves.

Yellow dogtooth lilies, much less common in Illinois prairie groves than the familiar white version, produce many more leaves than flowers, making the beautiful blossoms particularly precious finds.

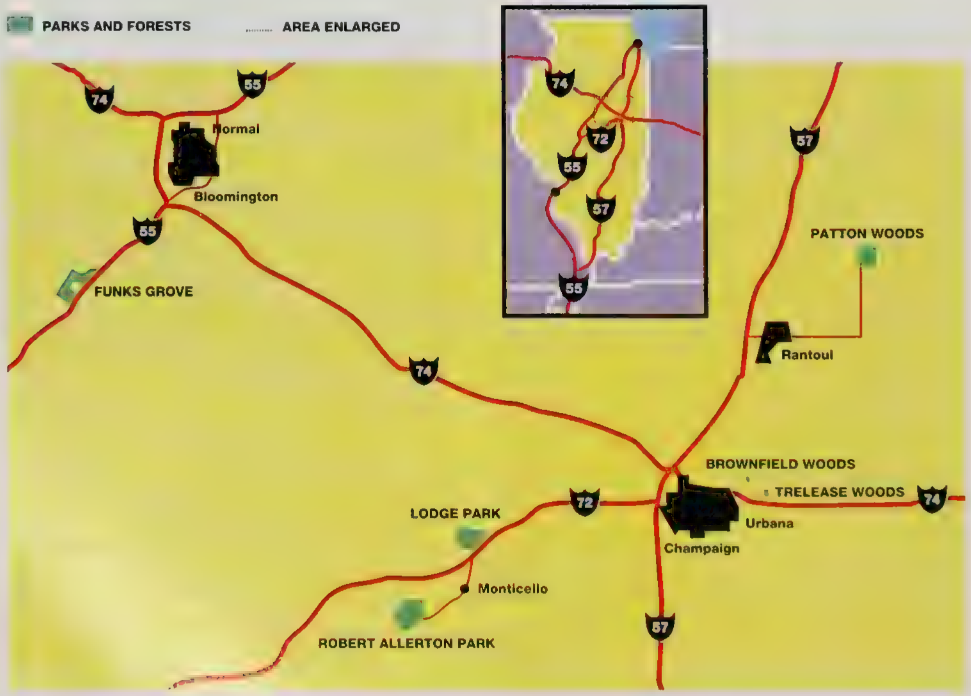
These savannas soon developed into one kind of prairie grove. For this reason, and others, the savanna habitat has almost disappeared from Illinois.

Further evidence supports the argument that other types of prairie groves or woodlands, those not formed from savannas, are remnants of the extensive post-glacial forests and not merely islands of colonizing plant species. In these prairie groves, a remarkable number of plant species, especially spring-blooming herbs, are found. The accidental transport of this diversity of plant life to an island community is improbable because of the great distance between the groves and the forests from which potential colonizing plant species might have come.

The Prairie Grove of Today

Over the decades, these isolated woodlands have undergone serious disturbances and have actually suffered from the absence of fires. The oak-dominated groves are giving way to sugar maples; invasive, weedy species are outcompeting the once dominant forbs in the understory. Yet the groves continue to exist along major streams and in other protected sites on the prairie, their square shapes following section lines and often leading the uninformed observer to conclude that they have been planted. Funks Grove, Trelease Woods, and Brownfield Woods in central Illinois still offer sparkles of color after the long gray winter and provide a glimpse of the Illinois prairie grove of 200 years ago. ■

The authors crisscross the state in all seasons of the year with cameras and notebooks in hand. They are currently working on a book of photographic essays documenting the natural wonders of Illinois. Susan L. Post is an Assistant Research Biologist in the Center for Biodiversity at the Illinois Natural History Survey (INHS) and Michael Jeffords is an Associate Scientist in the Center for Economic Entomology and the liaison for public relations and education at the INHS.



Funks Grove, Patton Woods, Robert Allerton Park, and Lodge Park offer glimpses of prairie groves as early settlers found them years ago. Brownfield Woods and Trelease Woods are not open to the public except for special field trips under the supervision of the University of Illinois' Committee on Natural Areas.

THE FUTURE OF OUR ENERGY RESOURCES

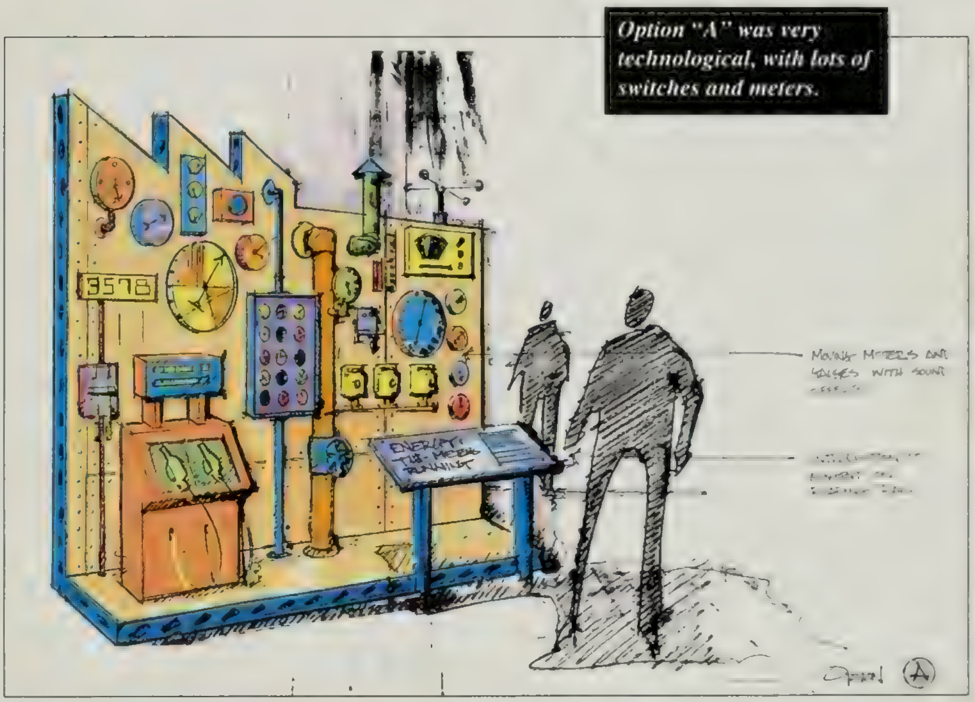
Will We See the Light?

by Carolyn Arden Bresler

Picture this familiar scene: an armchair sits in a living room, a glowing lamp on a small table beside it. A book lies open, face down on the table. In a corner of the room a television gives off a pulsing blue light, and on the wall a clock gently ticks. It's your average American living room in action.

Now here's the pop quiz. What kind of energy do you see in this imaginary picture? Electricity, of course, to light the lamp, run the clock, and give the TV its unearthly glow. But geologist Jonathan Goodwin sees a whole lot more than that.

"What about the energy used to produce the book on the table?" asks Goodwin, who is senior geologist and assistant chief for the Illinois State Geological Survey. "A significant amount of energy was used to cut down the trees, to run the paper mill and printing press, and to operate the author's word processor. Energy was even consumed by the person who owns the book when he or she went to the store by car or bicycle or on foot to buy it."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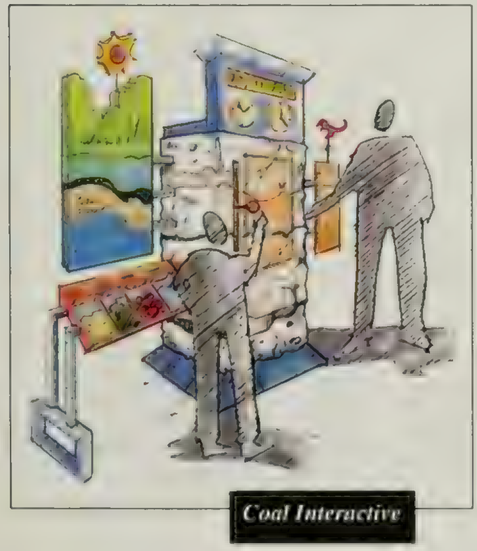
ENERGY
MOVING METERS AND GAUGES WITH SOUND

Option "A" was very technological, with lots of switches and meters.

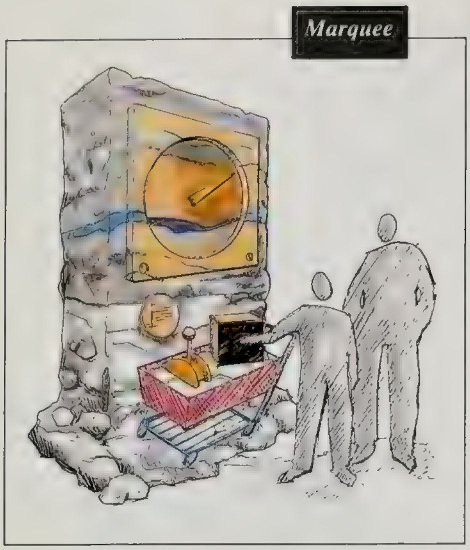


Coal Interactive

Goodwin isn't being difficult, he's just trying to make a point: that energy is not always what it appears to be. The idea of a "living room of energy" was dreamed up last fall by a team of exhibit designers, educators, and scientists working together to create a public exhibit on natural energy and energy conservation. Sponsored by The Chicago Academy of Sciences and the Nature of Illinois Foundation, the exhibit will travel throughout the Midwest—reaching more than one million people. It will open at the Academy next fall. The project team, of which Goodwin is a member, includes experts from the Illinois Scientific Surveys, Fermi National Accelerator Laboratory, Argonne National Laboratory, and the International Laboratory for Visitor Studies.

In their first brainstorming session, the team members tried to come up with a strong opening concept—a visual way to draw people into the exhibit. How do you get people interested in learning about energy? Start with something familiar, they thought. Construct a living room filled with everyday objects such as lamps, a television, a stereo, and an air conditioner, and let people see just how much energy they use in their daily lives. The message was simple.

But Goodwin didn't buy it. "The question is, how deeply do you want to


Marquee

analyze that scene?" he says. "Looking at the book alone, you can see that energy is involved in almost every step of its production. Energy is so deeply interwoven into our way of life that we are almost completely unaware of it. That's one of the things that makes it so difficult to deal with."

A year ago, the concept for an exhibit on energy was just a flickering light in the minds of the staff of The Chicago Academy of Sciences. "We knew that we wanted to do something on energy and that we wanted to reach the entry-level audience," says Carol Fialkowski, the Academy's vice president for education and exhibits. But as Goodwin pointed out, energy is, by its very nature, complex.

"We weren't sure how to approach such a broad topic and make it useful and meaningful to those people," says Fialkowski. "So we went out and asked them."

The Public's Energy I.Q.

Under the direction of Dr. Chandler G. Screven, an authority on museum-visitor evaluation and director of the International Laboratory for Visitor Studies at the University of Wisconsin/Milwaukee, audience research was conducted to evaluate the preliminary goals and objectives of the exhibit.

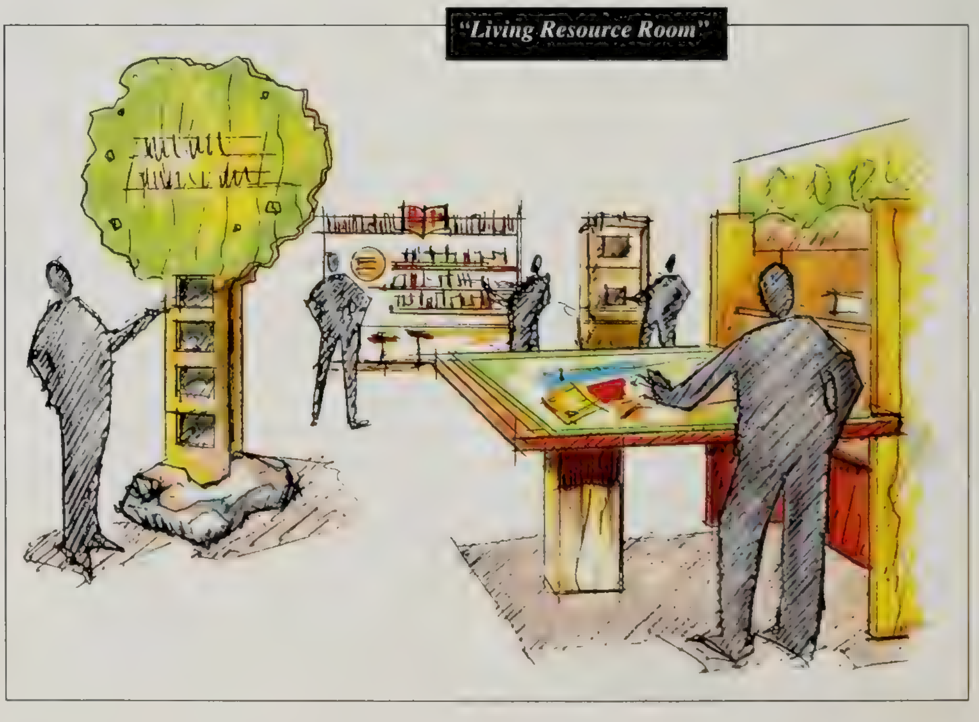
A variety of surveys were administered to passersby at six different sites: a Chicago shopping mall, a rural state fair, a downtown office cafeteria, The Chicago Academy of Sciences, Field Museum, and the park outside of Lincoln Park Zoo. The people surveyed ranged in age from 9 to 70. The questions were designed to test public knowledge and awareness of energy in four basic areas:

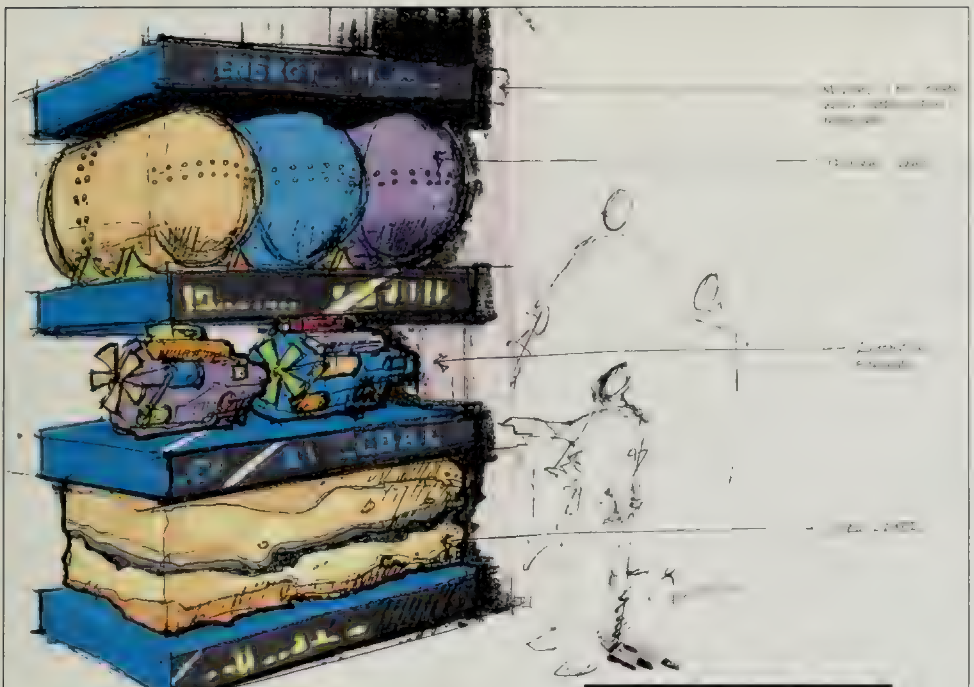
- knowledge of the mechanics of how energy is produced and the different resources involved;
- knowledge of energy supplies and the resources needed to meet our present and future energy needs;
- sensitivity to environmental problems associated with energy production, such as storage of radioactive waste and pollution from burning coal;
- an individual's disposition to take action about energy use, conservation, environmental issues, and laws aimed at improving the use of energy.

About two-thirds of the 388 people surveyed were able to identify the sun as the ultimate energy source, but less than 20% could make the proper connections from the sun to power-generating sources such as coal, oil, and nuclear energy. When asked to numerically order items involved in the production of electricity from coal, only 10 to 20% of those surveyed could create an appropriate chain from the sun to coal to electric light, and only half identified the sun as the first step in the chain. About 25% correctly chose nuclear energy as the largest source of electricity in Illinois.

When asked which personal actions they would be willing to take—to either save money or ensure a cleaner environment—people most frequently chose lowering their thermostats and turning off lights (65-85%), followed by buying energy-saving materials (60-80%), using more energy-efficient transportation (40-50%), and getting politically involved (15-20%).

What did all of this mean for the energy exhibit? "We learned that people were most concerned about the issues that have an immediate impact on their lives," says Fialkowski. "We also came to the realization that to concentrate on the technological aspects of energy transfer—from light energy to chemical energy to heat energy—would be a whole exhibit in itself. Even the most educated people we


"Living Resource Room"



Option "B" showed layers of rocks or geological strata, representing sources of fossil fuel.

interviewed were unable to make the proper connections between the sun, coal, and electricity—and they didn't care!"

Wanted: A Positive Message

Another type of survey was conducted during a members' night event at the Academy. Visitors were shown three illustrations of potential opening displays for the energy exhibit and interviewed for their reactions. The title on all three drawings was "Energy: The Meter's Running." Drawing "A" was very technological, with lots of switches and meters; drawing "B" showed layers of rocks or geological strata, representing the sources of fossil fuels; and drawing "C" combined a huge, bright-orange meter with a shopping cart filled with everyday appliances.

None of the options elicited very positive responses. Through personal interviews, researchers discovered that the visitors felt constantly bombarded with negative messages about the future of the world's energy. The title given to the exhibit, "Energy: The Meter's Running," was just another negative message. "We learned that people were sick and tired of hearing about the problems, and that they wanted to know what they could do to help solve them," says Fialkowski. "This showed us that our exhibit had to be more positive, if we wanted people to come and see it."

With this valuable audience input, a "new and improved" exhibit began to take shape. A new test title was chosen: "Our Energy Future: The Choice is Yours," and three goals were established: 1. to assist the visitor in understanding the extent to which our daily lives depend on the use of energy; 2. to assist the visitor in experiencing the costs and consequences of our current energy consumption; 3. to evaluate, with the visitor, ways in which individual actions and choices can affect energy use.

The exhibit designers constructed a prototype of an opening display for the exhibit to be used in another survey. In this display, a large meter and dial were centered on a free-standing wall. In front of the wall was a shopping cart filled with boxes painted with images of appliances such as a hair dryer and a mixer. Slides depicting other energy-related images such as homes, cars, and street lights flashed on a prototype video screen. When the visitor flipped a switch next to the monitor, an energy message such as "turn off the lights" appeared on the screen.

This simple, black-and-white prototype was tested with Academy visitors over a period of two weeks. The test was undertaken for two reasons: to see if visitors understood the basic concept, and to see if the display would attract their attention and make them want to enter the exhibit. According to Janice Siska, the academy's manager of visitor services who directed the evaluations, the initial responses were poor. "Our first day was very discouraging," she says. "Nobody liked it, nobody got it. But everybody had lots of suggestions."

The exhibit designers added extra dials, drew in rocks and geological strata, and painted parts of the display with bright colors. The next visitor test had very different results. "The majority of people understood that the concept was about energy conservation," says Siska. "The degree to which they understood it depended primarily on how much prior experience they had with the topic. We had 9-year-olds who came in and explained it to their parents, and we had parents who came in and explained it to their 14-year-olds."

Loaded With Solutions

Based on the results of the surveys, the original concept of a "living room of energy"—which focused primarily on the problems of energy use—was changed to accentuate the positive. The project team decided to make the last section of the exhibit a "living resource room" loaded with solutions. It will feature a display of energy-saving devices for the home such as appliance timers, setback thermostats, and oil recycling kits; books and brochures on recycling, alternative energy, and other energy conservation ideas; instructions on how to conduct an energy audit at home, school, or work; and a Talk-Back Board inviting visitors to jot down ideas, give their input, and create their own energy saving solutions.

An interactive computer system will challenge visitors to make individual choices about energy as they enter different areas of the exhibit. Upon entering the museum, each visitor will receive a bar-coded ticket that allows them to log on to this network of computers. A terminal in the living resource room at the end of the exhibit will give visitors an "energy score" based on the actions that they chose, and will show them how their choices would impact energy resources, the environment, or the economy. The Academy plans to use the visitor data collected by this program to analyze public responses and favored solutions to energy problems.

A major section of the exhibit on fossil fuels will explore coal, oil, and natural gas. Visitors will learn about the natural processes that form fossil fuels, the rate at which they are being consumed, and what the costs and benefits are for each energy source. This section will also explore the many alternatives to fossil fuels, such as nuclear energy, solar energy, and wind power. The familiar problems associated with nuclear energy will be covered here, along with the less-familiar, positive news of current research efforts—particularly at Illinois institutions such as Fermilab and Argonne—to develop improved nuclear technologies.

The exhibit will be filled with interactive components designed to get visitors of all ages directly involved with learning about energy. There will be videos to watch, switches to push, and handles to pull. Components are being evaluated through additional tests with visitors during this formative phase, and, during its six-month run at the Academy, the exhibit will continue to be evaluated for its effectiveness in attracting and holding public attention and conveying the desired messages.

Educational Programs

The Academy is developing a series of public programs in conjunction with the exhibit. These will include demonstrations on alternative energies such as solar and wind power; field trips to coal-burning power plants; family workshops on how to do an energy audit at home; a lecture series on current energy issues; and a children's summer-camp program. Storytelling programs will feature costumed characters representing the fossil fuels—coal, oil, and natural gas—who will discuss their similar origins and involve the audience as participants in the story.

Survey scientists serve as consultants to the exhibit on matters older than the hills, varied as alternate energy, and new as state-of-the-art computer technology. Wayne Wendland (left), state climatologist, Illinois State Water Survey, and Jonathan Goodwin (right), senior geologist and assistant chief for the Illinois State Geological Survey. (ISGS photo by Joel Dexter)

Teachers and schoolchildren are an important audience, and the Academy plans to engage local teachers in designing an educational package that will tour the Midwest with the exhibit. The package will include instructions for self-guided class tours of the exhibit and energy-related lesson plans for the classroom. Fermilab is also assisting the Academy in developing a resource base and bibliography for teachers.

Fialkowski sees all of this as a way of making the exhibit and its message reach the widest audience possible. "I think we've moved awareness one step down the line by providing people with all the tools we can imagine for them to take action," she says.

Economic factors are important to individuals making decisions about their energy use, and the exhibit team is taking this into account. "The economic issues are a major motivator for people to change their lifestyles," says Fialkowski. "In some cases, people may realize 'if I save energy, I save money.' But we're not going to present these economic benefits in an unrealistic manner. We're not proposing, for example, that a poor family in Chicago is going to save a lot of money by putting in solar panels. There are other ways to conserve energy. Keeping your car tuned up and your tires inflated at a certain level will reduce your oil consumption, reduce your cost, and also contribute to cleaner air. So it's a win-win situation."

An important goal of the exhibit is to help visitors make informed decisions about their own energy use. Another is quite simply to get people to think about energy.

"I hope people will walk away from this exhibit with an understanding of how important energy is to them," says Goodwin. "Energy is more than flipping a light switch or turning a key in the ignition. It's our way of life." ■

The energy exhibit opens next fall at The Chicago Academy of Sciences, 2001 North Clark Street at Armitage. The museum is open 10 am to 5 pm seven days a week. Admission is $1 for adults, $.50 for children (ages 3-17) and seniors. For more information, call (312) 871-2668.

Carolyn Arden Bresler is a science writer and director of media relations and publications for The Chicago Academy of Sciences. She lives in Chicago and rides her bike to work to burn energy and conserve it at the same time.

Working drawings for the exhibit courtesy Abrams, Teller, Madsen, Inc., Craig Wetli, lead designer

REMEMBERING GAYLORD DONNELLEY

"When your goal is in sight, you raise your sights"

Gaylord Donnelley
Founder and Chairman
The Nature of Illinois
Foundation

An ocean of ink has been devoted to documenting Gaylord Donnelley's extraordinary life, a fitting tribute to the man who once led the world's largest commercial printing firm. His legacy includes an army of dedicated friends and thousands of acres of precious protected land. Over the years, scores of outdoor recreation and conservation organizations, historic preservation societies, and civic and cultural institutions have benefitted from his generosity and commitment; during his life, he was honored by universities and statesmen. Most recently he was named winner of the Chevron Conservation Award in the Citizen Volunteer category. He was to go Washington, D.C. in May to be honored at an awards banquet.

The Nature of Illinois Foundation was one of Gaylord Donnelley's inspired dreams. "Gaylord knew that the Surveys were among the most important resources in the state," said Gerald Adelmann, executive director of the Open Lands Project. "The high quality of their research had national significance and they needed the support of the private sector to insulate them from the budget's axe. They needed a vehicle to tell their story. The Foundation was to become that vehicle."

Prairie Chicken
Sanctuary
No
Trespassing

Dorothy and Gaylord Donnelley. Work on the endangered prairie chicken led to the vision of a society to support the work of the Illinois Scientific Surveys. (Department of Conservation photo, c.1966)

Here we offer, not a compendium of his many accomplishments, but the memories of those who brought the Surveys to his attention in the first place—and others who worked with him to create a "society" to support their important work.

A Vision Born in the Blinds

"I MET GAYLORD DONNELLEY when a group of us were raising funds for the endangered prairie chicken and our friendship flourished right along with our plans for that project. Gaylord and Dorothy Donnelley's enthusiasm, their contributions and gifts of land were invaluable. The prairie chicken connection led us to hunt together and when the ducks were not flying, which sometimes happened, we would sit in the blinds, discussing a variety of conservation issues. One of these was the possibility of a support organization for the Surveys—and that was the beginning." *Glen Sanderson, Principal Scientist Emeritus, Illinois Natural History Survey (INHS)*

"IT WAS 1981. I WAS the new chief at the Natural History Survey, and it was only a day or two before Gaylord Donnelley's name came up. It kept coming up, and before long I met him and we became friends. Gaylord had a great understanding of the Surveys—the importance of research for itself and its importance in decisions that needed to be made in Illinois. An idea began to crystallize: the Surveys should forge a formal relationship with the business community. He never lost time in getting to the heart of the issue." *Paul Risser (Vice President for Research, University of New Mexico, Albuquerque)*

"MY FIRST MEETING WITH Gaylord 'to get the society up and running' was on a snowy, sleety, miserable afternoon in that magnificent office of his. He thought I was reserved. I thought he was reserved. We got over that fast."

"Out rolled the maps of Illinois as we tried to put together a balanced Board of Directors—to see 'who we know.'

(Actually, who Gaylord knew.) Work plans on programs, fundraising, and communications were hammered out. In those first five years, things began to happen: publication of the magazine, *The Nature of Illinois*, fundraising visits, press receptions, legislative receptions, seminars with the Surveys, The Biodiversity in Illinois exhibit, videos for Illinois schools on the state's natural resources."

"Gaylord always knew exactly what the Society should do—promote the invaluable research of the Surveys and the Hazardous Waste Center. But the name of our organization, The Society for the Illinois Scientific Surveys, drove him and everyone else crazy. 'SISS,' Gaylord would chuckle, 'not much punch in that.' We wrestled with that for five years." (The name was finally changed to The Nature of Illinois Foundation in July 1990.)

"He was a unique man in a world full of cynics and quid-pro-quos. He always did the right thing...and he had fun doing it. I will miss him so much." *Jane Bolin, Executive Director, 1985-1990, The Society for the Illinois Scientific Surveys*

"LIFE SOMETIMES TAKES peculiar turns. I first met Mr. Donnelley in 1982 while I was with the Department of Energy and Natural Resources. I attended a meeting with him in which the idea came up of forming an organization (along the lines of The Smithsonian) to raise public awareness of the Surveys. Mr. Donnelley agreed that such an organization was needed and he became the founder and chairman of what is now called The Nature of Illinois Foundation. Eight years after that meeting, I left state government to become the organization's second executive director." *John Schmitt, Executive Director, The Nature of Illinois Foundation*

"MEMORIES SPIN THROUGH my mind. His generosity of spirit, for example. He was always active physically and mentally, but when he could no longer hunt quail, he went by horse-drawn wagon to observe his friends enjoy hunting quail on his plantation. And when we went hunting at Ashepoo, South Carolina, Gaylord always insisted on poling the boat to the duck blind, rattling the blind to chase out any cottonmouths, and encouraging me to take the first shot. Unquestionably, Gaylord Donnelley was the finest person I have ever known." *Frank Bellrose, Principal Scientist Emeritus, INHS*

The rehabilitation of the Gaylord building, the first major restoration project of the Illinois & Michigan Canal Corridor, earned a special citation from former president Reagan in 1988. (Courtesy of the Advisory Council on Historic Preservation, Steve Stewart photographer)

"GAY WORKED DIRECTLY with the Surveys encouraging their efforts in so many ways. Above all, he was a sincere human being, treating all he met with respect. I feel honored to have shaken his hand, to have shared time with him, and to have enjoyed his wisdom. The Water Survey has lost a friend, but we have gained a lasting memorial to him in The Foundation." *Richard G. Semonin, Chief Emeritus, Illinois State Water Survey (ISWS)*

"HIS WISE COUNSEL AND insightful comments on complex issues will be difficult to replace." *Mark E. Peden, Acting Chief, ISWS*

"GAYLORD WAS A REAL friend of the environment and natural resources, and he was a good friend and supporter of the Surveys and HWRIC. His presence will be missed." *David Thomas, Director, Hazardous Waste Research and Information Center (HWRIC)*

"HE INSPIRED AND GAVE new life to everyone he touched. He had a rare passion for people and the quality of our environment. His leadership will be missed but his legacy will benefit all of us well into the next century." *Gary D. Miller, Assistant Director, HWRIC*

"THOSE WHO WOULD number themselves, or would be numbered by others, as friends of the natural resources of Illinois are legion. Among those, Gaylord Donnelley, has earned our special attention and gratitude. He devoted much of his life to active participation in outdoor activities, and he understood that the future of such activities can not be assured without everyone's help. He enthusiastically addressed developing natural resource problems to benefit future generations. Gaylord's relationship with the Natural History Survey was unflagging over the decades. His unfailing optimism, wise counsel, generous support, and love of nature have sustained the staff through both good and challenging times. He will be greatly missed." *Lorin I. Nevling, Chief, INHS*

"WE SHALL REMEMBER Gaylord Donnelley for his deep interest in and strong support for the Surveys. Our common interest—to seek a better understanding of our natural resources—formed a natural bond between us."

"Through his efforts, The Nature of Illinois Foundation has made significant progress in helping to make the Scientific Surveys better known among the public, and in building recognition for the value of scientific research in making intelligent environmental policy decisions. Gaylord's unstinting support for The Foundation and the Surveys has helped to create networks to communicate the results of scientific research and to foster cooperation between the Surveys and various institutions throughout the state. The work has ranged from this informative and educational magazine, to the *Biodiversity in Illinois* exhibit which has traveled throughout the state, to helping develop and sponsor a new traveling exhibit on Energy with the Chicago Academy of Sciences in Chicago."

"His support has been crucial in times of budget crises and other threats to our existence as public service organizations dedicated to research and information on Illinois' natural resources. Gaylord's guidance at the helm of The Foundation will be sorely missed. We owe him an undying debt of gratitude for helping the Scientific Surveys' beacons of excellence in research and service to shine more brightly." *Morris W. Leighton, Chief, Illinois State Geological Survey*

Members of the Board

Members of the first Board of Directors included Edmund Thornton. Their common bond as Yale alumni was reinforced in the 60s when Donnelley was a member of the Nature Preserves Commission of which Thornton was chairman.

"GAYLORD WAS AN exemplary business executive and he carried those skills over to his other interests. He was very committed to the preservation of the natural environment and had the great vision of a society that would support scientific work and protect the Surveys from the shifting winds of legislative change. Although he was direct, he was the consummate gentleman, tactful and modest. A true and loyal friend." *Edmund B. Thornton, President, The Edmund B. Thornton Foundation*

"THREE WORDS PERSONIFY Gaylord: generosity, sincerity, and humility." *Walter Hanson, Founder Hanson engineering*

"GAYLORD DONNELLEY'S lifelong dedication to his native state of Illinois and, in particular, the conservation and protection of its natural resources gave him a keen appreciation of the unique role of the Surveys. More than others, he understood that the basic research, to which the Surveys' distinguished scientists were committed, was vital to an understanding of the resources—land, water, and atmosphere—on which the present and future of Illinois depends. During the mid-1970s he became increasingly concerned that the Surveys, while recognized internationally for their expertise and integrity, were underfunded by the state government to which they rendered such singular service." *Henry Barkhausen, former Board Member and Director of the Illinois Department of Conservation 1970-73*

The special service recognition award of the Wildlife Society, usually reserved for professional wildlifers, went to Gaylord Donnelley in 1989. (Francis N. Saterlee photographer)

"WHENEVER YOU WENT TO Gay with an idea, you got a hearing and if the idea was creditable, you could count on his support. And he was not just a passive supporter. He was involved. Last year, even though his health was failing, he came down to the Cache River dedication and he and Dot (Mrs. Donnelley) rode around like hundreds of other visitors, in a stuffy van, up and down bumpy roads looking at all the places—Heron Pond and Little Black Slough, the land dedicated to the Bellrose Reserve—in which he had been such a key player." *Al Pyott, Board Member since 1987, and Executive Director, The Illinois Nature Conservancy*

There was a saying of Gaylord Donnelley's of which I was particularly fond. After reading an enlightening article or hearing an especially informative talk, his eyes would sparkle and he would say, with great satisfaction, "I have just learned something I didn't know before." Those of us who have had the pleasure of knowing him and working with him might paraphrase that, "We have learned a lot we would never have known without him." Jean Gray, Editor ■

SURVEYING ILLINOIS

CURRENTS
Illinois State Water Survey (ISWS)

Biorhythms has been set aside until the fall issue in order to make room for the tribute to Chairman Donnelley.

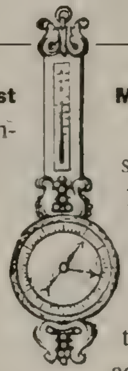
ISWS Acid Rain Measurement Adopted as World Standard

The method developed by the Water Survey to measure the components in acid rain has been adopted by the International Union of Pure and Applied Chemistry (IUPAC). "This is important because the study of acid rain has global rather than regional implications," says Survey analytical chemist Jane Rothert, "and IUPAC recognition means that standardized methods will now be used worldwide. We will be able to compare notes with London, New Zealand, or Upper Siberia and know that we're all doing our measurements the same way."

IUPAC is the third standardization organization to adopt the ISWS method for use in acid rain monitoring. Previous approvals were granted by the U.S. Environmental Protection Agency and the American Society for Testing and Materials.

The method was developed by researchers Jane Rothert, Sue Bachman, Brigita Demir, and Mark Peden, and published in *Pure and Applied Chemistry*, June 1991.

How Was the Weather Last Month?



The Water Survey's monthly *Water and Climate Summary for Illinois* has been mailed to water users and water monitors across the state for the past eight years. Commodity traders and farmers use the report's precipitation and soil moisture data to predict crop yields when buying and selling crop futures. Farmers with private wells and managers of municipal water systems use precipitation figures to predict groundwater levels. (Advance planning can be valuable in times of severe drought or unprecedented high rainfall.)

Internally, Survey scientists use rainfall distribution figures to predict lake and river levels a month in advance and to predict groundwater conditions two to three months in advance. In addition, ongoing documentation of regional weather change is a valuable tool for researchers in the new ISWS Global Climate Change Program.

The *Water and Climate Summary* is available through the Office of Publications Services, Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820, (217) 333-8888.

Water Quality Information on Tap

Spurred by the typhoid epidemics of the 1890s, Arthur Palmer (the Water Survey's first chief) spearheaded the scientific study of the quality of drinking water in Illinois. That study remains a major focus of the Water Survey; however, mineral content surfaces as one of today's top concerns, not typhoid.

More than 750 water samples were submitted for analysis to the Public Service Lab at the Water Survey last year. An additional 850 inquiries were handled by phone or mail. About half of the requests came from private citizens concerned with household water problems. The remainder came from industry, well drillers and engineers, farmers, university and institutional administrators, water treatment equipment dealers, government and public health officials, recreational managers, doctors, dentists, and veterinarians.

Chemist Brian Kaiser tests a water sample in the Water Survey's Public Service Lab. (ISWS photo)

A homemaker may bring a sample of wash water that has stained the laundry orange. A farmer may bring a sample of livestock water after noting a high death rate among his piglets. A doctor may submit a sample of the tap water to be used by a patient on a low-sodium diet. Or a city official may bring a sample from the municipal water supply to have the flouride content checked.

After water samples are analyzed and the factors that might have caused the problem are evaluated, Survey chemists submit a written report, including suggestions for solutions. Often the solutions are simple, according to Brian Kaiser, chemist with the Office of Analytical & Water Treatment Services. Other times additional consultation and follow-up may be required.

Water samples must be taken using an ISWS collection kit that is customized for the water problem in question. Because this is part of the Water Survey's Public Service Program, there is no charge for either the kit or the analysis.

A phone call to Kaiser at (217) 333-9234 or 0802, is the first step toward a solution to public or private water problems.

GEOGRAMS
Illinois State Geological Survey (ISGS)

Isotope Lab Rates High Marks

The Survey's Isotope Geochemistry Laboratory is exceptionally accurate when it comes to radiocarbon dating and lab supervisor Jack Liu recently received news to prove it.

Last year, the lab was one of more than 100 radiocarbon-dating facilities worldwide invited to participate in radiocarbon testing of five samples supplied by the International Atomic Energy Agency (IAEA) in Vienna, Austria. The Survey's laboratory staff was eager to participate in the radiocarbon dating project "to test how good our system is," said Liu, who scheduled the IAEA samples into the laboratory's regular workload over a six-month period.

A comparison of results found that two of the Survey's analyses were virtually identical with the corresponding IAEA values and three were within one standard deviation. Only two other labs had all of their results within one standard deviation for all five samples. Sixteen labs came within three standard deviations. The five samples supplied by IAEA to each of the 100 participating labs were marble, freshwater shell, paper, and two fossil woods.

Jack Liu, supervisor of the Isotope Geochemistry Lab

A Lifetime of Service Brings an Award

Dr. Keros Cartwright, a 30-year veteran of the Geological Survey, recently received the Geological Society of America's George Burke Maxey award for distinguished service in hydrogeology. Cartwright is principal geologist and head of the Special Studies and Hydrogeology Research Lab at the ISGS. He originally joined the Survey in 1961, rising in 1984 to the senior position of Principal Geologist and Head of the General and Environmental Group. Cartwright returned to full time research at the ISGS in 1988.

Over the years, Cartwright was Visiting Associate Professor of Geology at the University of Waterloo, Ontario, and Adjunct Professor of Geology at Northern Illinois University, DeKalb. He has been Adjunct Professor of Geology at the U. of I. Urbana since 1985.

Cartwright is an active member of the leading geological and hydrological scientific organizations, is on the editorial boards of several scientific journals, and serves on technical committees for the furtherance of earth sciences. He has published more than 110 scientific papers and reports. His principal areas of study are groundwater and related geological characteristics of rocks.

George Burke Maxey, for whom the award was named, served the field of hydrogeology for more than 35 years, heading the Geological Survey's groundwater section from 1955 to 1961.

Keros Cartwright, head of the Hydrology Research Lab

Gary Salmon injects an oil sample into the mass spectrometer.

New Source of Old Oil

The discovery that a deep source of oil exists in Illinois has been documented by geochemists at the ISGS who analyzed oil samples recovered in the drilling of a 7,900-foot well. Their analyses indicated that the oil came from Ordovician or Cambrian source rocks some 500 million years old.

This finding is important because, for more than 30 years, major oil companies have been looking for evidence of a source of deeper oil. Until now, the only proven oil source in the Illinois Basin has been from Devonian-age rocks located at depths between 2,500 and 5,500 feet, although preliminary work on some Ordovician-age rocks has suggested they, too, could be a source.

Although no commercial quantities of oil have been found below 5,500 feet, according to Stephen T. Whitaker, geologist in the Oil and Gas Section, it is possible that a commercial reservoir full of hydrocarbons exists at unexplored depths in Illinois.

The challenge now is to find the source rock itself so that its occurrences can be mapped.

(ISGS photos by Joel Dexter)

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

HWRIC Project Reduces Waste in Metal Coating Process

A new ultrafiltration process developed by HWRIC for manufacturers of metal products reduces hazardous waste, is highly cost effective, and improves product quality.

The problem faced by one central Illinois manufacturer of metal shelving—a problem quite common among such manufacturing facilities—was that metal parts arrived at their plant with a thin coating of oil to prevent rusting and had to be immersed in an acidic bath in order to degrease the surfaces and coat them with an agent that promotes paint adhesion. Oil would build up during the bathing process, and 5,000 gallons of hazardous waste had to be disposed of three times a year at a cost of $1.00 per gallon.

After going through several lab and on-site stages, HWRIC scientists found that oil buildup in the bath could be significantly reduced through an ultrafiltration process. This process involves pumping the contaminated liquid, under low pressure, through a cylinder which contains a membrane filter column. Small amounts of clean material weep through the membrane, leaving the contaminants behind. The clean fluid is returned to the bath solution, while the contaminated fluid continues to circulate and be cleaned, thus becoming more concentrated. On January 7, 1992, the new process was put in place at the manufacturer's Bloomington facility.

Ultrafiltration device in HWRIC's pilot lab (HWRIC photo)

Results to date indicate that hazardous waste generation can be reduced through ultrafiltration from 15,000 gallons to approximately 30 gallons annually—a reduction of more than 99%. Furthermore, a decrease in the amount of chemicals needed to recharge the bath solution means additional cost savings. Payback from investment in this technology should take less than a year.

As an added bonus, the product itself was improved, so much so, that the manufacturer's chemical vendor has brought other customers involved in related types of manufacturing to observe the new ultrafiltration process. Although this initially may mean decreased sales of chemicals, the vendor believes that, in the long run, customer satisfaction will more than make up for a temporary lower volume of sales.

In April, Tim Lindsey, HWRIC pollution prevention technology engineer, traveled to Washington to deliver a paper on the project to leading managers, engineers, consultants, attorneys, legislators, researchers, and regulators across the country. Lindsey is also preparing a publication describing the new technology. The publication, funded under a grant from the EPA, will be available through the HWRIC Clearinghouse Library soon.

The UN Comes to Champaign

In January, United Nations (UN) and U.S. Environmental Protection Agency (USEPA) computer programmers came to HWRIC from Bombay, Paris, and Washington, D.C. to work on an international pollution prevention program. This project expands the Waste Reduction Advisory System (WRAS) bibliographic database begun by HWRIC more than six years ago in cooperation with the USEPA.

The UN group agreed on an extended case study format which will include:

1. types of waste involved,
2. information on reduction of waste volume and toxicity,
3. cost savings and impact on product quality, and 4. who to contact for detailed information.

The computer program, designed by HWRIC, becomes part of a worldwide network that can be accessed by modem—for the price of a phone call— through the USEPA or UN Central Computer Program. Diskettes are available for those who wish to add the information to their PC database, for those who do not have access to a modem, and for parts of the world where phone service is unreliable.

"Although pollution prevention goals overlap worldwide, in the West we come at it from a slightly different perspective and use different terminology," says Dr. Gary Miller, Assistant Director and Pollution Prevention Manager at HWRIC. "The exciting part of this program is that this practical information is being translated into non-Western, internationally accepted terms, making it accessible to developing countries."

HWRIC continues to work with other states and the National Roundtable of State Pollution Prevention Programs to coordinate case studies to add to the database. USEPA gathers case studies through other federal agencies. The UN is gathering case studies through international groups.

The selection of WRAS as the basis for this computer program allows HWRIC early access to case studies worldwide and gives broad visibility to the pollution prevention accomplishments of Illinois companies.

BUILD AN EXHIBIT AND THEY WILL COME

by Susan L. Post

Illinois is a complex mosaic of habitats, each with a surprising variety of plants and animals. Influenced by its glacial heritage and underlying geology, the state is a meeting ground for organisms from widely divergent geographical areas: the eastern deciduous forest, the western great plains, the southern coastal plains, the Ozark uplift, and the northern forests.

Biodiversity in Illinois, a traveling exhibit developed by the three Scientific Surveys—Natural History, Geology, and Water—with the support of The Nature of Illinois Foundation, illustrates the diversity of organisms found in Illinois and explains why they are here. Included are explanations of how the geology of Illinois contributed to an abundant variety of organisms and how climate interacted with landforms to create distinct habitats that support species as diverse as prickly pear cactus and native pine, snapping turtles and wild turkeys.

Natural Habitat

Biodiversity in Illinois *was on display at the Springfield Boys and Girls Club last February. (Photo courtesy of the State Journal-Register, Rich Saal photographer)*

An Exhibit on a Shoestring

A brown grain truck and a tan van pull up to a loading zone and disgorge a variety of makeshift boxes, pedestals, gray fabric panels, and a mummified snapping turtle. With the help of an electric screwdriver and several pairs of hands, the exhibit *Biodiversity in Illinois* soon materializes.

The idea for *Biodiversity* began with Estie Karpman, then Assistant Director of the Society for the Illinois Scientific Surveys (now The Nature of Illinois Foundation), and Dr. Michael Jeffords, Public Relations and Education Officer for the Natural History Survey. "It began with the challenge of obtaining a grant and matching funds," says Estie. "Although we didn't get the grant, Marine Bank donated the matching funds."

"No one would believe we could build something like this. Michael and I were told to pursue the idea and if it worked, fine, but don't expect too much." says Estie.

Biodiversity in Illinois was chosen as a subject that could involve all three Surveys. Using a discarded pesticide display, fabric donated by Weeks Upholstering, Springfield, wood donated from Handy Andy Home Improvement Centers, Inc., Springfield, photographic developing donated by Kodalux, and the magic of the Natural History Survey's workshop, nine panels, three specimen boxes, and four pedestals took shape. Each survey was in charge of producing exhibit materials for one of the large half-circle panels. The common thread of the exhibit was the *Natural Resources of Illinois*, a Natural History Survey Special Publication, and the 14 natural divisions of Illinois and the various factors that helped mold them. A trifold brochure gave visitors an overview of the exhibit.

Panels were filled with colorful photographs of Illinois organisms and habitats, maps depicting the natural divisions of Illinois, and information on geology and climate. Collections of fossils, bats, birds, insects, mammals, mussels, reptiles, amphibians, and fishes were displayed as well as a great horned owl, a wild turkey, and a mummified snapping turtle. The turtle, a rust brown color reminiscent of Ramses II, elicits the most response from young and old alike, with questions like: "What is it?", "Where is it from?", "Will it bite?", and "Why is it brown?"

On the Road

Biodiversity in Illinois premiered at the Marine Bank, Springfield, in October 1989. From there it traveled to branches of Marine Bank in Champaign and Decatur. Since then, the exhibit has toured 18 locations throughout the state—from banks to nature centers, junior colleges to shopping malls, and even the Illinois State Fair where in excess of 100,000 visitors had an opportunity to see it.

With each setup and takedown, the crew became more efficient at packing and new space was found on the truck; other components were soon added to the exhibit. A six-foot wooden praying mantis now welcomes visitors; an electronic question-and-answer board tests their knowledge of the nature of the state, using photographs of organisms and habitats (the touch of a button provides the correct answer); and two tables with the newest and best nature books (donated by the Chicago Public Library's NatureConnections project) tempt children to "learn more about it."

Planning a Visit

To aid schoolchildren who visit the exhibit, teachers were encouraged to use the Biodiversity folder, packed with information developed by the three Surveys. Included was a pamphlet, *Winter Storms*, from the Water Survey; and leaflets entitled *Pleistocene Glaciations in Illinois*, *History of Pennsylvanian Rocks*, *Landscape and Mineral Resources of Illinois*, *Geograms on Erratics*, *Ancient Dust Storms*, *Trilobite*, and *Resources for teaching Geology*, all from the Geological Survey. Information on the concept of biodiversity, classroom activities, and a large coloring poster of more than 60 Illinois species was provided by the Natural History Survey.

By 1991, a new teacher packet, *Biodiversity in Illinois – A Teacher's Guide*, had been developed by the Natural History and Geological Surveys. This guide allowed the instructor to preview the exhibit before actually visiting it. Concepts introduced on the panels were further explained and reference material was given. Discussion questions and activities were suggested that would make the trip more valuable for the students and enable the instructor to integrate the experience into the science curriculum. Although the accompanying guide requires the student to read and study much of the exhibit, the activities are fun and allow students to glean a tremendous amount of information about the state's biology, geology, and climate.

An Exhibit for All

Not all activities were geared toward schoolchildren. At a Grandparents Day held in Decatur, children and their grandparents visited, reminisced, and interacted with the exhibit. One grandmother was overheard telling her granddaughter about a woods she and her sisters had roamed as girls, picking the abundant wildflowers for the tables of an inn her parents had operated. Sadly, she explained how both the inn and the woods were now gone.

At several locations, evening lectures were offered in conjunction with the exhibit. These lectures, given by scientists of the three Surveys, ranged in topic from "Illinois Wilds" to "Impacts of Weather on Social and Economic Activities." At Market Place Mall in Champaign during Earth Day Expo 1990 and at the 1991 State Fair in Springfield, *Biodiversity* was staffed by Survey employees.

Thousands of people, both young and old, have explored *Biodiversity in Illinois*. Even a seeing-eye dog at Carl Sandburg College expressed interest in the mounted birds. "*Biodiversity in Illinois* is basically a public education effort," said Leo Welch, a Biology Instructor at Belleville Area College. "It will increase the understanding of what is remaining in terms of plant and animal life in Illinois."

The success of *Biodiversity in Illinois* can best be summed up in the words of one visitor: "I never knew the state had so much. A truly wonderful exhibit!" ■

Girl meets owl, one of the specimens in the exhibit, during Earth Day Expo in Champaign.

Biodiversity in Illinois was retired for renovation after its visit to Rend Lake in southern Illinois in April 1992. For information on availability of the exhibit next fall, write The Nature of Illinois Foundation, 208 S. LaSalle Street, Chicago, IL 60604, or call (312) 201-0650.

ILLINOIS DEER

A Not-So-Endangered Species

by Peter Friederici

By the time the shot comes, the afternoon light is almost gone from the brushy fields of Shabbona Lake State Recreation Area and the December cold has long since penetrated the Department of Conservation's (DOC) old Ford Bronco. "Let's do some 'rasslin'," says Bob. Like the four other shivering volunteers, he has been waiting for an hour, watching dozens of deer on the brushy fields—grazing, running, eyeing the truck.

Suddenly sparks flash across the field like an incipient fireworks show. "Everybody hanging on to something?" asks Mike, the driver, and without waiting for an answer he rams the truck across the rutted dirt, toward a cloud of smoke half a mile away, visible even in this gathering darkness.

Hungry deer will eat leaves, twigs, and sometimes even bark.

The Roundup

Charlie and another man are already there, huddled over the dark forms barely distinguishable from the ground. This time Charlie has trapped four deer in the rocket-powered net. One of them groans. The loud, wrenching sound could come from a goat.

The volunteers hurry across the dark cord mesh and over the slick of shelled corn that drew the deer in. Everyone finds an animal to hang on to. Two of the deer are young antlerless bucks that have been caught before and already wear numbered white plastic tags on their ears, so all that is needed is to let them go. It's not so easy. Several people kneel around the first deer and hold on to legs and head while Charlie works each limb free of the net, one at a time. The buck strains against the net, against the hands and arms; he stares wildly.

Charlie has to cut a few cords to get the buck free. When he is done, all four people around the deer let go and leap backwards as one on Charlie's count of "One-two-three!" Then Charlie yells and the buck streaks off into the darkness.

The procedure is repeated on another buck that has not been caught before. After working the legs free Charlie measures a hind leg and the chest girth with a tape measure so caked with old mud that he has to wipe it between his gnarled fingers, over and over again, while the knees of the volunteers ache on the hard dirt, frozen and pitted by the hooves of dozens of deer. Then he pierces both ears with a pair of pliers that leaves behind two large white plastic tags.

It is hard, grueling work for deer and humans alike. Charlie Nixon is a wildlife biologist with the Illinois Natural History Survey (INHS), and for the next few months he will be watching these deer roam the park and out into the rest of DeKalb County, recording where they wander and how and when they die. The data he gathers here and in a twin study at Siloam Springs State Park in western Illinois will enable him to create computer models that will predict the population demographics of Illinois deer. It is the sort of unsung, behind-the-scenes study that results in mountains of statistics and may help us to live better with the other animals that share the land.

A Very Successful Comeback

Ninety years ago you would have had trouble finding four white-tailed deer, *Odocoileus virginianus*, in all of Illinois

An adult doe was captured with rocket nets at O'Hare Airport by INHS and released in Will County as part of a study to determine the survival of translocated deer. (Photo by Jim Witham)

Decades of largely unregulated hunting had extirpated this once-common animal from much of the Midwest. By the time deer hunting was outlawed in 1901, the animal was probably entirely gone from Illinois.

Reintroduction programs brought them back. Deer reproduce quickly in favorable conditions, and they found abundant food and shelter in the patchwork of field and forest that covers much of the state. The original predators that had kept the deer population in check—wolves, cougars, Native Americans—had been wiped out, and in their absence the deer thrived.

By the late 1950s firearm hunting had once again been legalized in some counties. Still, in many places deer sightings remained a special occasion into the 1980s. Steve Packard of The Nature Conservancy remembers his first encounters with deer in Chicago-area forest preserves in the 1970s: "It was wonderful to see those first footprints. We thought it was wonderful to have another bit of the original fauna back."

Fences are highly effective at keeping deer out of a yard—if the fences are eight feet high.

By now he has had second thoughts. The deer have returned with a vengeance. There are probably between one-third and one-half million in the state, and their success has brought trouble:

- reports of collisions between deer and motor vehicles on state highways doubled between 1985 and 1990;
- deer on densely-populated Chicago-area forest preserves show a high incidence of malnutrition;
- biologists report increasing complaints of deer depredation on row crops, nurseries, orchards, and residential gardens;
- overgrazing by deer has put heavy pressure on native plants and may have wiped out rare species in some areas.

All these problems focus on one question: How many deer is enough? There is no one good answer. Scientists can't agree among themselves. To many biologists, deer have been primarily a game animal, a resource whose populations should remain high to satisfy hunters. But some botanists feel that the high deer populations game managers strive to maintain are ultimately destructive to the plant life the deer feed upon.

Most studies suggest that somewhere between 10 and 30 deer per square mile can sustain themselves in most of Illinois without unduly damaging their habitat. But "we don't have a good handle on what presettlement densities were like," says Brian Anderson, director of the Illinois Nature Preserves Commission, though he suggests that year-round hunting may have kept deer populations at even fewer than ten per square mile.

In the absence of historical data, biologists must look instead at what makes sense now. And in managing deer, biologists must also manage public opinion, for deer represent different things to different people: they are an aesthetic pleasure and a symbol of the wild, a source of food and recreation, a hooved pest.

Population Control

The primary means of controlling deer populations has historically been hunting with a firearm or bow and arrow. Public sport hunting of deer is legal in 98 of Illinois' 102 counties. In the fall of 1991, hunters reported bagging 81,550 deer, the highest total ever. The statewide picture may seem to show that sport hunters have effectively taken the place of the wolves and the Native Americans. Up close, though, that's not quite true.

Some critics feel that hunting isn't a very effective means of population control. For one thing, many hunters prefer bagging antlered bucks rather than does. Deer are prolific breeders, and they are polygamous, so a herd with many does can multiply rapidly even if there are few bucks. Last fall the DOC began issuing special permits allowing hunters to bag more deer—if they aim at animals without antlers. It remains to be seen whether DOC can fine-tune its permitting enough to address local overpopulation problems.

Perhaps hunters can bag enough does to balance the number of fawns born each spring. But much of Illinois—including many state parks—is off-limits to hunters. In and near such refuges, it is the motor vehicle that unintentionally becomes the major predator. Statewide, 9,076 deer-vehicle collisions were recorded by the Illinois Department of Transportation on state highways in 1990, up from 4,517 in 1985, and only a portion of the 14,012 recorded from all Illinois roads.

In 1990 more than 14,000 deer-vehicle collisions were recorded from Illinois roads.

Rock Cut State Park is a case in point. For decades no hunting was allowed in this 2,742-acre park on the outskirts of the Rockford metropolitan area. Deer flourished; by the late 1980s biologists estimated that there were 500 deer in the park, a density of 88 per square mile. They typically spent nights in the park and fed on nearby cornfields at dawn and dusk. Farmers complained about crop depredation. And to get to the cornfields, deer had to cross roads. By the fall of 1989, says Rock Cut park ranger Kelly Nelson, "You'd have two deer hit a night. It wasn't a pretty sight, and it was unsafe."

An adult buck is marked with cattle tags and ear streamers for easy visual identification (Photo by Jim Witham)

DOC officials responded by opening, in the fall of 1989, the first-ever public archery hunting season in the park. Archers bagged just over 50 deer—a relatively small impact on the population. Many of the neighbors were outraged. "You don't want to see a deer with an arrow in it running through the park," says Mary Ann Aiello, a local county board member who opposed the hunt. "And they were dressing the meat right there, so you'd walk through the park and see a pile of guts lying there."

In the winter of 1990-91, the DOC allowed another public archery hunt; but later that winter it also organized a team of volunteer sharpshooters who shot deer at bait stations while the park was closed. All told, 214 deer were killed. The meat from the deer killed by sharpshooters was donated to county food pantries. Because public resistance to an open hunting season at the park continues, the controlled hunt may well become a yearly ritual from now on.

As one manager of a large residential development in Jo Daviess County puts it, "It's the same as any other maintenance item. You mow the lawns in the summer, plow the streets and crop the deer in the winter."

Through the mid-1980s, Jim Witham and Marty Jones conducted an INHS project analyzing urban deer. They found high deer densities at Busse Woods in the Cook County Forest Preserve system, Ryerson Conservation Area in Lake County, and other areas. They also found a high rate of malnutrition among those deer.

Busse Woods is a dedicated Illinois Nature Preserve that was widely considered the most biologically valuable woodlot in northern Cook County. But by 1983, 26 species of spectacular springtime wildflowers had vanished. What's more, trees and shrubs had a pronounced "browse line" six feet high, showing that deer had eaten all the leaves, twigs, and sometimes even bark. Ground-nesting birds and other animals disappeared with the plan

Ninety years ago you would have had trouble finding four white-tailed deer in all of Illinois. Today there are between one-third and one-half million in the state.

The INHS study culminated in an experimental management program. Deer at Busse Woods were shot by marksmen or trapped and euthanized. The population was reduced to 10 to 15 per square mile by 1987, and has been kept there by regular winter cullings since then. Chris Anchor, a wildlife biologist with the Cook County Forest Preserve District, says the deer are in better condition now. So are the plants. Oak seedlings are back, and so are a few of the spring wildflowers, though Anchor says their regeneration is "painfully slow." The seeds of many woodland wildflowers are not readily dispersed; even if they were, there is no place near Busse Woods for them to spread from. The Purple Twayblade, Maple-leafed Goosefoot, and other regionally rare species may be gone for good.

These days Marty Jones manages the DOC's Urban Deer Project. It is his job to field calls from suburban residents who complain that deer are eating their shrubs and flowers. He says the number of complaints is on the rise, though he admits that may be due to increased public awareness of his position.

When Jones gets a complaint, he gives landowners a number of options. Fences are highly effective at keeping deer out of a yard—if they're eight feet high. Burlap or plastic tubing around tender plants can keep the deer away, though they may rob a suburban yard of that woodsy look. The chemical repellents you can spray on shrubs to make them taste bad work, sometimes—but when deer are hungry, they'll eat just about anything.

It is on the larger properties within Jones's purview—such as the Chicago Botanic Garden, or other lands owned by county forest preserve districts—that he may consider more drastic measures. Every year Jones grants some permits that allow landowners to use "lethal removal" techniques on deer herds. In the winter of 1990-91 four land-owning agencies in Cook, Lake, and DuPage counties received permits allowing them to kill 114 deer. The venison from those deer was delivered to local charities.

Lethal removal is controversial. In 1988 a local citizens' group opposed to a culling program at Ryerson Conservation Area in southern Lake County raised over $50,000 to help live-trap 21 deer and transport them to Wildlife Prairie Park outside Peoria. Forest preserve officials maintained that was not enough and persisted—in the face of demonstrations, fierce verbal battles, and even death threats—in killing 39 more. Every winter since, the Ryerson herd has been kept at a small size by wintertime shooting.

Public opposition has quieted, partly because of a vegetation monitoring program that measures in great detail the effects of grazing on forest-floor plants. "People who oppose lethal removal will second-guess you on everything," says Marty Jones. "Before anyone contemplates a deer-herd reduction, they need complete documentation."

Monitoring has shown that the showy white-flowered trillium—a favorite of deer and human visitors alike, and a good indicator of the health of all the ground flora—is coming back.

Public opposition may also have faded because the alternatives to lethal removal are not easy ones. Trapping and relocating is time-consuming and expensive, but it is impractical mainly because it's hard to find a place to take the deer. "There are so many deer that there's no place to put them anymore," says Charlie Nixon. Some researchers are working on birth-control vaccines for wild animals, but it will be a few more years at least before they are effective and convenient.

And opposition may also have lessened precisely because the Ryerson control program, and others, got so much media coverage. The very heat of the controversy surrounding deer numbers may have burned a greater understanding of ecology into the public psyche. It taught the lesson that there is no living without dying, and that we, too, are part of the natural web all around us. ■

Peter Friederici is a freelance writer and editor in Chicago. He specializes in natural history and conservation and writes a quarterly report for the Roger Tory Peterson Institute of Natural History.

THE RACCOONS COME TO TOWN

by Margot Jerrard

On a night in late April when most people are asleep in bed, a city dweller is making her rounds. A female raccoon—easily identified by her thick, ringed tail and the black mask across her face—is hunting for food. She moves slowly, deliberately through an empty park and crosses the street, her head low to the ground, her sharp, pointed muzzle sniffing for acorns. Like all raccoons, she has excellent night vision and a keen sense of hearing. Suddenly a dog starts to bark.

The fur on her shoulders puffs up and the raccoon lopes to safety, her rear end higher than her front. She crawls into a storm sewer. Her teeth are bared, her ears flat as she waits to see if the dog will come to attack.

The domestic garbage can is an important element in the urban raccoon's life

"Life is hard for raccoons," says Biologist Charles Nixon, of the Illinois Natural History Survey (INHS) in Champaign. "They don't get a chance to make many mistakes."

In a few minutes the dog stops barking. The night is quiet again except for the sound of a far-away car, and the raccoon emerges and resumes her slow, flat-footed walk, looking for food. She had given birth to a litter of four small cubs earlier that month, and she is hungry.

When she became pregnant in February, the raccoon had searched for holes in trees or in the ground and had settled on a space in an empty garage attic. After a gestation of 63 days the blind babies were born. They had neither the black face mask nor the black rings on their tails, only barely visible dark pigment on their skin, which was covered with fuzz. Now that they are three weeks old, they are beginning to open their eyes and grow fur.

Originally woodland animals living near streams or rivers, raccoons have now also moved into cities and towns. There they make their dens and raise their young in holes in trees, in piles of brush or lumber or rubbish, squirrels' nests, even attics. While the people who built the city sleep, raccoons, who are nocturnal animals, are out hunting for food. The raccoon population has exploded since the 1940s, says INHS principal scientist, emeritus, Dr. Glen Sanderson. They are one of the most abundant fur-bearing mammals on the continent and live in all 48 contiguous states.

In the 1930s swamps and bogs were drained, nut-bearing trees were cut down, and dens were destroyed. The number of raccoons declined

Raccoon painting courtesy of Beverley Sanderson, Champaign, Illinois

But in 1943, the raccoon population began to grow. Scientists cannot explain why. Sanderson, who has published almost 100 papers and has been editor of the *Journal of Wildlife Management*, estimates that there are 15 to 20 times more raccoons now. They have increased not only in Illinois but throughout North America and have moved where they had not been earlier—prairies, deserts, and salt marshes. They live as far south as Panama and now have moved so far north into Canada that the native Indians, who are encountering them for the first time, had no word in their language for this bright-eyed, ring-tailed creature. The first recorded sighting of a raccoon in the Canadian province of Manitoba was in 1947.

Whatever the reason, raccoons have come into cities.

Sanderson says the raccoon, which belongs to the Procyonidae family and is related to the kinkajous and coatis of Central and South America, is the most intelligent native wild animal. It is also inquisitive.

With its sensitive five-toed paws, a raccoon can reach through a one-inch wire mesh, pick up a needle or a nail, and then turn and feel the object repeatedly, palpating it with its paws as if to ascertain what it is. However, the one thing that most people "know" about raccoons is wrong, says Sanderson. They do *not* wash their food in water, even though their Latin name (*Procyon lotor*) means "the washer." Only captive raccoons submerge their food in water, not wild raccoons, and even many captives just pick up their food from the feeding dish and place it directly in their mouths. He speculates that some captive raccoons may douse their food because the palms of their paws become more sensitive when wet.

The raccoon is the most intelligent native wild animal in North America.

Biologist Nixon says that, in the wild, raccoons fish by getting into the water where they move their front paws constantly, delicately, under the water until they catch something. While they are fishing their heads are up, as if they are looking at the stars or admiring the night sky. Nixon thinks that a caged raccoon may hold its food under water as a substitute for normal behavior, a way of going through the motions of catching it first.

Raccoons are also found in state parks where they have learned to flip up latches and open coolers. Nixon and University of Illinois veterinarian Laura Hungerford are analyzing how the foods in state parks, the same foods city raccoons eat, affect their health. They do not yet know the reason, but park-dwelling raccoons' teeth and gums are much worse than those of wild raccoons.

Although they are classified as carnivorous, raccoons eat almost anything, including frogs, birds, small mammals, insects, corn and other grains, fruits, and most foods prepared for humans or domestic animals. In summer a raccoon fills up on beetles and grasshoppers, and all year round it eats garbage and carrion. In the midwest, corn is the food eaten most frequently. As many householders have learned, a raccoon can take the lid off a garbage can with its handlike paws and tip the can over.

But in this city tonight the foraging raccoon digs up some acorns buried by a squirrel last fall and a few earthworms. Soon she returns to her den and settles down to nurse her hungry babies who make a quiet "churring" sound of contentment.

In Illinois most conceptions occur in mid-February, and in April, litters of small blind, nearly furless cubs are born. The female raccoon rears only one litter a year, and the young stay with the mother through the summer, fall, and winter.

When the young are ten weeks old, the mother takes them outside. She climbs from the garage to a nearby tree and goes head first down the trunk. The little ones follow and begin to travel with her. She still feeds them with her milk until they are about 15 or 16 weeks old, but they are beginning to eat other food. They forage in gardens, backyards, and dumps. She shows them where to find insects to eat and wild grapes, persimmons and pokeberries, as well as birds and birds' eggs. If they are near water, she will show them how to catch nesting waterfowl. One night she climbs a garbage can and, perched on the rim, reaches in for corn cobs, which she throws down to her cubs who wait below.

Raccoons do not hibernate, although, Charles Nixon says, they behave as if they will. In the fall they begin to eat a great deal and gain an immense amount of weight, most of it fat. When the weather turns cold they hole up and stay without eating for days at a time, losing as much as 25% of their weight. But they need water and come out of the den to eat snow or lick ice.

Raccoons are solitary animals, not social, but, in extreme cold, male and female raccoons of all ages pile into the same den to keep warm. Nixon has found as many as a dozen raccoons in a hollow tree, and larger groups in barns. Unlike some wild animals, the mature male raccoon, although territorial, is not a threat to the young ones.

On good days, when the winter sun shines and warms the air, the usually nocturnal raccoons emerge from their dens, stretch out in the sunshine, and doze, their long, coarse fur soaking up heat. Nixon once came upon a raccoon sunbathing on top of an old squirrel's nest. When Nixon swung a grapevine attached to the tree, the raccoon woke with a start, jumped 30 feet down to the ground, and disappeared into the woods.

In February, the mating season, the sexually active males hunt for receptive females, marking trees with their scent. By then the young are on their own and must fend for themselves. Females do not go as far to search for a home, but a young male may travel as far as 30 or 40 miles before he finds a place where he will not be chased away by the male who dominates that territory. The dominant male has a range of several miles in which he has first choice of food and females, and he does not welcome adolescent males.

All young raccoons are vulnerable. Hunters, trappers (in fall and winter only), and cars cause the greatest number of deaths, and small raccoons are in danger from rural dogs as well as from great horned owls who can swoop soundlessly down and catch a plump youngster in their talons.

The water-loving raccoons thrive in bottomland forests, along streams, in hardwood swamps and marshes and around reservoirs. Now they are thriving in the middle of cities. Where there is no river or lake, raccoons find birdbaths, swimming pools, and irrigation and drainage ditches.

A chain-link fence is no deterrent to the wily raccoon.

Scientists who study raccoons agree that they are intelligent. Veterinarian Laura Hungerford has observed a family of raccoons who stayed hidden so well that they were invisible until one of the people who had given them food came along. Then, recognizing the generous human, the raccoons emerged from their dens to beg.

Sanderson estimates that the average life span of a wild raccoon is seven years, but some captives have lived as long as 12 or 15. Although the average weight is 12.3 pounds, he has found two males weighing more than 25 pounds.

Raccoons in the north are heavier and have longer, darker, and denser fur, as well as shorter tails and smaller ears. Sanderson says that raccoons seem able to fight off many kinds of injuries. He has seen a raccoon that lived with a piece of wire embedded in its body.

Sanderson does not advise keeping a raccoon as a pet. They can transmit diseases to humans and to domestic pets, and they are wild animals that can turn vicious with no warning. (In most states, including Illinois, it is illegal to keep a wild-caught raccoon in captivity.)

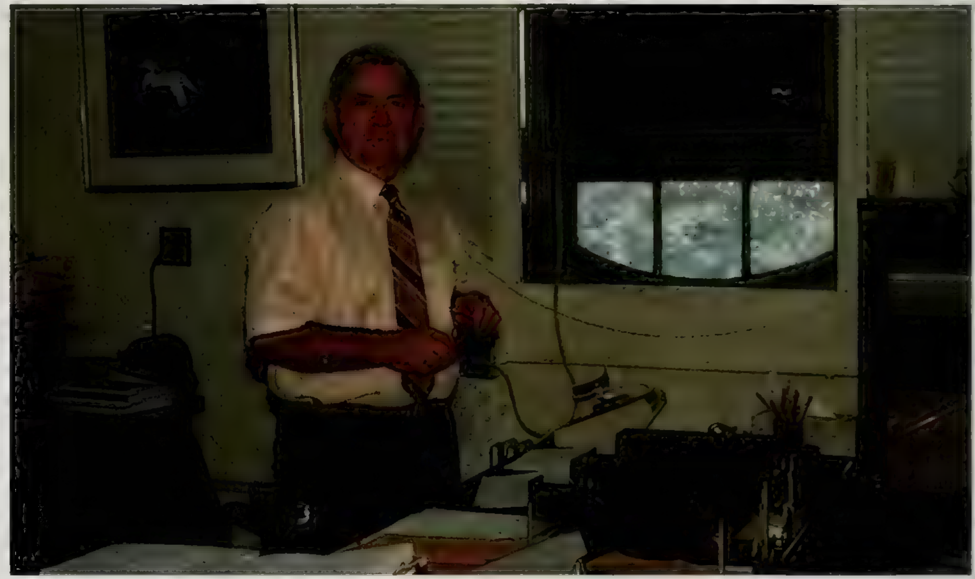
Raccoons are clever creatures and stories of their ingenuity abound. An Illinois couple came downstairs one morning to find their pet cat agitated and acting as if he were starved. Noticing the screen door was open, they decided to keep watch. They found that each night a raccoon walked up to the screen door, worked the handle until the door opened, came into the kitchen, and ate up the cat's food. Then the raccoon loped outside to drink at their swimming pool before continuing on its rounds. ■

Margot Jerrard is an Urbana-based writer who worked for twelve years as an editor for the University of Illinois before leaving last year to spend full time writing. Her garage was home to a mother raccoon and three cubs one recent spring

Top Award Goes to Wildlife Scientist

"Dr. Sanderson has made enormous contributions to the wildlife profession and done a remarkable job as Director of the Center for Wildlife Ecology. He has been a top-notch administrator as well as a colleague, role-model, and friend to his staff. He is never too busy to help but takes little credit. He is the 'silent soldier' behind the accomplishments of the Survey wildlife programs."

Stephen P. Havera, Director,
Forbes Biological Station
Illinois Natural History Survey (INHS)



Award Winner Glen C. Sanderson

Dr. Sanderson received the Aldo Leopold Award for distinguished service to wildlife conservation at the 57th North American Wildlife and Natural Resources Conference, April 1, 1992. The Aldo Leopold Award is the highest honor bestowed by The Wildlife Society and the ultimate recognition of a wildlife professional.

Dr. Sanderson's award places the Survey in the unique position of being the only institution that has had more than one Aldo Leopold Award winner. Waterfowl biologist Frank Bellrose received the award in 1985 (See "Dean of the Ducks," *The Nature of Illinois*, Fall 1991). Tom Scott, head of the Survey's wildlife research section until 1963, won the award in 1982.

Dr. Sanderson, probably the world's leading authority on the biology and ecology of the raccoon, is also a highly respected waterfowl biologist and was a leader in efforts to preserve remnant flocks of critically endangered native Illinois prairie chickens. He has published extensively, been a prodigious editor, and been active in professional activities at local, state, national, and international levels.

Speaking of Raccoons

Although officially retired, Sanderson still maintains an office at the INHS and coutinues to work with and inspire his colleagues. He plans to pursue his career-long interest in raccoons and says:

"We do not know what factors are responsible for the decline of the raccoon in the early 1940s, or for its subsequent dramatic turnaround. Conventional wisdom says that cutting den and mast (food source) bearing trees, increased human populations, and over-harvest by hunters and trappers were responsible, but these explanations fall short when you realize that today we have fewer trees, urbanization is more widespread, and hunters and trappers take many more raccoons now than they did 60 years ago."

"In 1947, after I returned from World War II, I started research on the raccoon for my Master's degree at the University of Missouri. Raccoon numbers had already shown dramatic increases starting with the 1943 breeding season. I believed numbers would increase for a few years, perhaps remain high for a few years more, and then decline. Now, some 40 years later, I am still waiting for the decline and trying to learn why the increase occurred and why the numbers remained high for so many years."

"Now that I'm retired, I hope to look at the data and get some insights into why animal populations fluctuate. Animals other than the raccoon—for example, the coyote—have increased in abundance and expanded their range without any deliberate help from man. The white-tailed deer population, on the other hand, is the product of a too-successful program of reintroduction."

"Why do we study these abundant animals? One reason is that they are economically important to Illinois. Raccoons are hunted for food and for their pelts, and, in some states, they are hunted by many more people than hunt quail or waterfowl. And deer hunting is a multimillion dollar business, not to mention the pleasure we have viewing this graceful animal in the wild."

"But primarily, we study them because it helps us understand the biology of wild animals. All knowledge is useful. You never know when you're going to use something you've learned." ■

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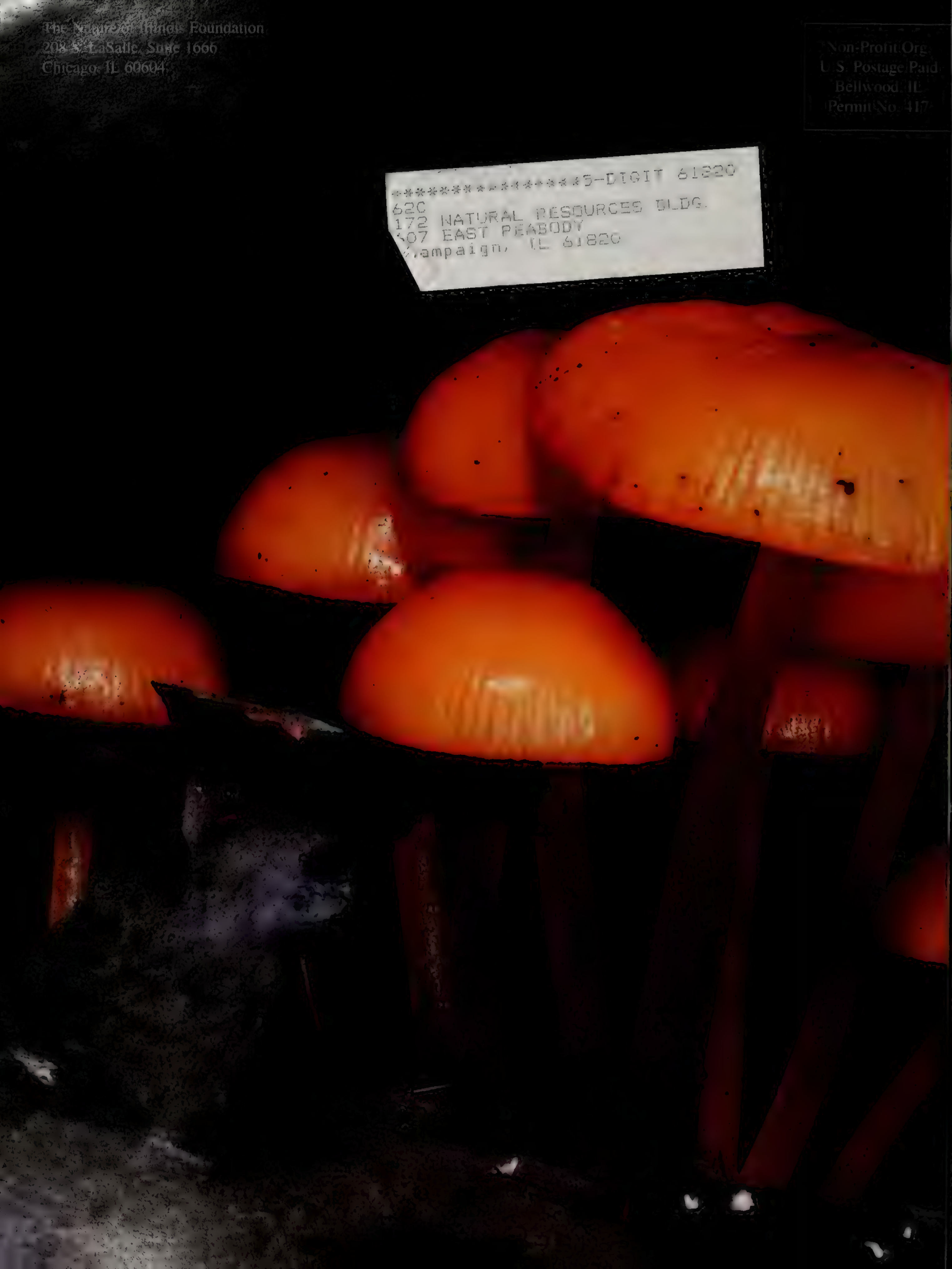

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THE NATURE OF ILLINOIS

Fall 1992

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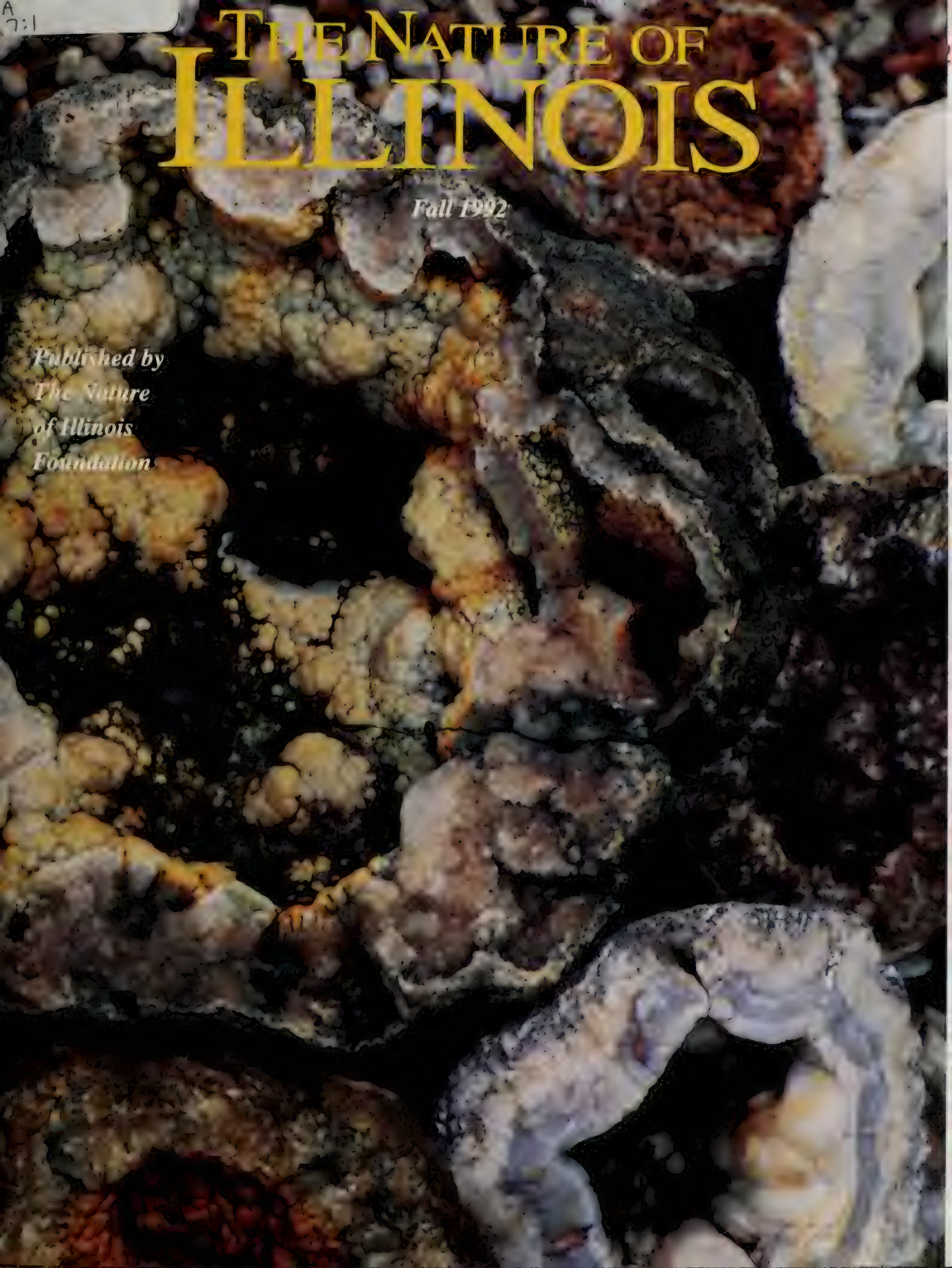

THE NATURE OF ILLINOIS

Fall 1992 – Illinois Underground

From the Foundation

Having studied geology in college and having spent the greater part of my life in the mining industry, I take great pleasure in welcoming you to this issue of *The Nature of Illinois*.

The study of geology has always fascinated me—first, because it helps me imagine the Illinois that existed eons before man first set foot upon the earth, and next, because it explains the world in which we live today. Fascinating to me, too, is the unfolding of knowledge about the wealth of mineral resources that helped build our cities and roads, and the plentiful water resources, coal, and oil that fuel our economy.

The articles in this issue uncover such topics as the history of oil exploration in Illinois; the drama of cliffs in limestone and sandstone that guard our major river systems; the fertile soils that overlay our flat plains and rolling hills; and the plain-looking geodes that conceal sparkling, multi-colored interiors.

It is the aim of this publication to relate something important, interesting, and perhaps even surprising about your home state, and also to let you in on some good news about Illinois. In this issue, we cover educational projects that prepare our youth for the future, and conservation efforts that are succeeding in bringing the majestic symbol of our nation back to Illinois' river shores. But it is our special intent to keep you informed about the work and research activities of the Illinois Scientific Surveys (Natural History, Water, Geological) and the Hazardous Waste Research & Information Center (HWRIC). Their work is vital to our health, our environment, and our economy, and their public service programs benefit us all.

We thank you for your readership and hope you will help support our efforts and the efforts of the Surveys and HWRIC by becoming a member of The Foundation if you have not already done so—or by renewing your membership if it has expired.

Cordially,

Edmund B. Thornton

Edmund B. Thornton
President, Board of Directors

The Nature of Illinois is published by The Nature of Illinois Foundation in support of the Illinois Scientific Surveys (Natural History, Water, and Geological) and the Hazardous Waste Research and Information Center. These four agencies span the state's natural resources and have a 150-year history of data collection, research, and service. Their activities encompass hundreds of vital research projects; educational outreach; and technical assistance to private citizens, government, business, and industry.

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Hancock County geodes. Photo by Joel Dexter

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Editorial Staff
Jean Gray *Editor*
Michael Jeffords *Photographer*

Design
Mobium Corporation, Chicago

Stay In Touch
Name and address changes and membership information should be sent to The Nature of Illinois Foundation, 208 S. LaSalle, Suite1666, Chicago, IL 60604. (312) 201-0650. Master Card and Visa accepted.

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OCT 15 1992

CRUDE QUEST: THE SEARCH FOR OIL IN THE ILLINOIS BASIN

by William Furry

The history of oil exploration in Illinois is not unlike the great whale hunts in the South Seas a century and a half ago. Here in the prairie state, independent oil producers—like those seagoing adventurers who chased the leviathan from New Bedford to New Zealand, filling their cargo holds with precious whale oil—roam the Illinois Basin searching for oil, "harpooning" the landscape in hopes of raising a spout of another sort: a gusher.

Crude oil is as whale oil was—a finite resource. In the first decade of this century, the United States was the leading oil-producer in the world and Illinois ranked third in the nation for petroleum production. Today, however, the U.S. produces 20% of the world's oil, and Illinois is 15th among the oil-producing states.

What happened?

The hundred-year history of petroleum production in Illinois has been dramatic. Booms have come and gone, and fortunes have been won and lost. But over most of the last three decades, oil production in the state has steadily declined. The major oil companies have pulled up stakes from the drilled-out Illinois oil fields, moving their derricks to richer, more profitable oil beds in Siberia, Africa, and Southeast Asia.

Not everyone has given up on the Illinois Basin, however. Tenacious independent oil producers have inherited the oil fields. Together with geologists from the Illinois State Geological Survey (ISGS), they are working to find new and undeveloped deposits in the state. And Survey geologists are today exploring technologies that will revolutionize the future of oil recovery throughout the basin.

A flare caused by burning off excess gas in a Salem oil field

Thar she blows!

In 1880 oil was accidentally discovered in Litchfield, after drillers sunk a 150-foot bore rod into the floor of a 500-foot coal shaft. According to eyewitness accounts, oil rose and covered the floor of the mine "to the astonishment of all." For several years, crude petroleum was skimmed off the top of the oil pool and sold locally as a natural lubricant. Within a decade, a pair of entrepreneurs from Buffalo, New York—the Van Veck brothers—descended upon Montgomery County, sank several oil wells, and set up the first petroleum production company in the state. The Van Veck brothers sold their crude oil for twelve-and-a-half cents a gallon, about five dollars a barrel.

A few years later in Clark County, oil was found in sufficient quantity to warrant renaming a settlement "Oilfield." But drilling technology was very primitive in the early days of oil exploration. Although several holes were sunk, well cores were not lined, and the shafts were prone to flooding.

The commercial applications for petroleum products were just beginning to become known at the turn of the century. In a 1906 bulletin published by the ISGS, geologists marveled at the "wonderful changes" [illegible] by the oil industry

"The average person has but little knowledge of the many uses to which crude petroleum is put or the variety of products made from it in the great refineries. The most important and best known of these products is, of course, the illuminating oil known as kerosene, or 'coal oil'. This oil has become one of the greatest adjuncts of modern civilization; in fact, such a necessity to daily life that millions of inhabitants of this and other lands would find it difficult to do without." By the turn of the century, coal oil had replaced whale oil in the lamps illuminating the world.

There have been three distinct oil booms in Illinois. The first took place in the shallow oil fields of southeastern Illinois along the LaSalle anticline between 1905 and 1910. There in the Casey oil pool, petroleum production rose to 34 million barrels in 1908, and Illinois rose to a ranking of third in the nation among the oil-producing states. The industry grew so rapidly in Illinois and regulation was so lax, the ISGS issued a warning to investors in the Illinois oil fields to be wary of fake oil companies. "The highway robber who takes the money of his victim at the point of a gun," the Survey wrote, "is an honest man in comparison with some of these barefaced scoundrels who fleece victims of high and low degree with the glittering advertising sheets and stock certificates of their mushroom oil companies."

Oil production began to taper off after 1910, however, and Illinois fell to 14th among oil producers in the nation. In 1936 fewer than five million barrels of oil (42 gallons to a barrel) were pumped from the southeastern Illinois oil fields.

In 1937 the state's second boom began when oil was discovered in deeper regions of the Illinois Basin in Centralia, Clay City, and Louden. Discovery of oil in Salem in 1938 helped propel Illinois out of the petroleum cellar. In 1940 the state's oil production figures were a staggering 147,647,000 barrels—nearly five times the production of any single year in the 1980s.

In the post-war years production in the deep basin pools began to decline. By 1965 primary methods of oil production in the state accounted for only 20 million barrels annually.

Unlike the state's first two booms, the third significant oil-production period was brought about solely through advancement in technology. During the 1940s the state began experimenting with secondary oil-recovery technology: waterflooding. Primary oil-producing technology—pumping—recovers only 10-30% of the oil in the ground. Waterflooding, an extraction method whereby water is pumped into oil-bearing rocks, forces as much as 50% of the remaining oil into recovery wells, where it can then be pumped by conventional means. By the mid-1980s waterflooding accounted for more than 40% of Illinois' oil harvest.

Vanishing Elephants

Nearly everywhere you drive in the southern half of the state, you see the pumps of crude oil wells. Like giant insects they stand in the cornfields, valleys, and river-bottoms of the Illinois Basin, wingless mantids bobbing ceaselessly for food.

ISGS geologists Donald Oltz and Dennis Haggerty check the porosity of a sandstone outcrop in Southern Illinois in their search for oil in the Illinois Basin.

In the petroleum industry, Illinois is known as a stripper basin; most oil wells in the state strip fewer than ten barrels of oil a day out of the ground. Although some produce a great deal more, the typical Illinois well averages only a couple of barrels daily. While some *new* drillings may pump in excess of 500 barrels a day, production tends to drop off sharply after the first year or two. By comparison, oil production in Illinois is a far cry from that of Saudi Arabia, where a single well can produce tens of thousands of barrels each day.

In 1990 there were 1,850 oil companies doing business in Illinois. Although most oil producers in the state maintain fewer than five wells, 70% of the state's 56,000 wells are owned by large, independent or major oil companies. But according to a recent study published by the Illinois Department of Mines and Minerals, a regulatory agency for the state, "[T]he most significant trend to develop in the state's oil fields is the increase in the transfer of ownership of wells." More than 8,900 of the state's 42,000* oil production wells changed hands in 1990, the study reported, adding this postscript: "Especially noteworthy...was the transfer of large oil properties, previously operated by major oil companies, to independent oil operators."

In the last 20 years, several of the larger oil companies operating in the state— Exxon and Texaco in particular—have packed their derricks, sold their leases, and said farewell to the Illinois Basin. Newer, more lucrative oil fields in Siberia and off the coasts of China.

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*Refers to the number of wells actually in production.

Opposite: Roughnecks, so-called because of the rigorous demands of their job, add a section of pipe to sink the drill deeper into the earth. Roughnecks work 12-hour shifts around the clock until their job is done. Then they move on.

Indonesia, Thailand, and Australia, have lured them away from domestic oil reservoirs, where, in the parlance of the petroleum industry, "the elephants" have all been hunted down. The industry giants, never known to be the biggest risk takers, drill one or two wells in the whole state and, if they don't find oil, they move on.

Not everyone, however, including the U.S. Department of Energy, the ISGS, and most of the independent oil producers, believes all the elephants have been tracked down in Illinois.

The Department of Energy estimates there are 1.5 billion barrels of oil in Illinois reserves recoverable through conventional oil technology (waterflooding), and another 4.5 billion barrels in the ground that could be recovered using more sophisticated technology.

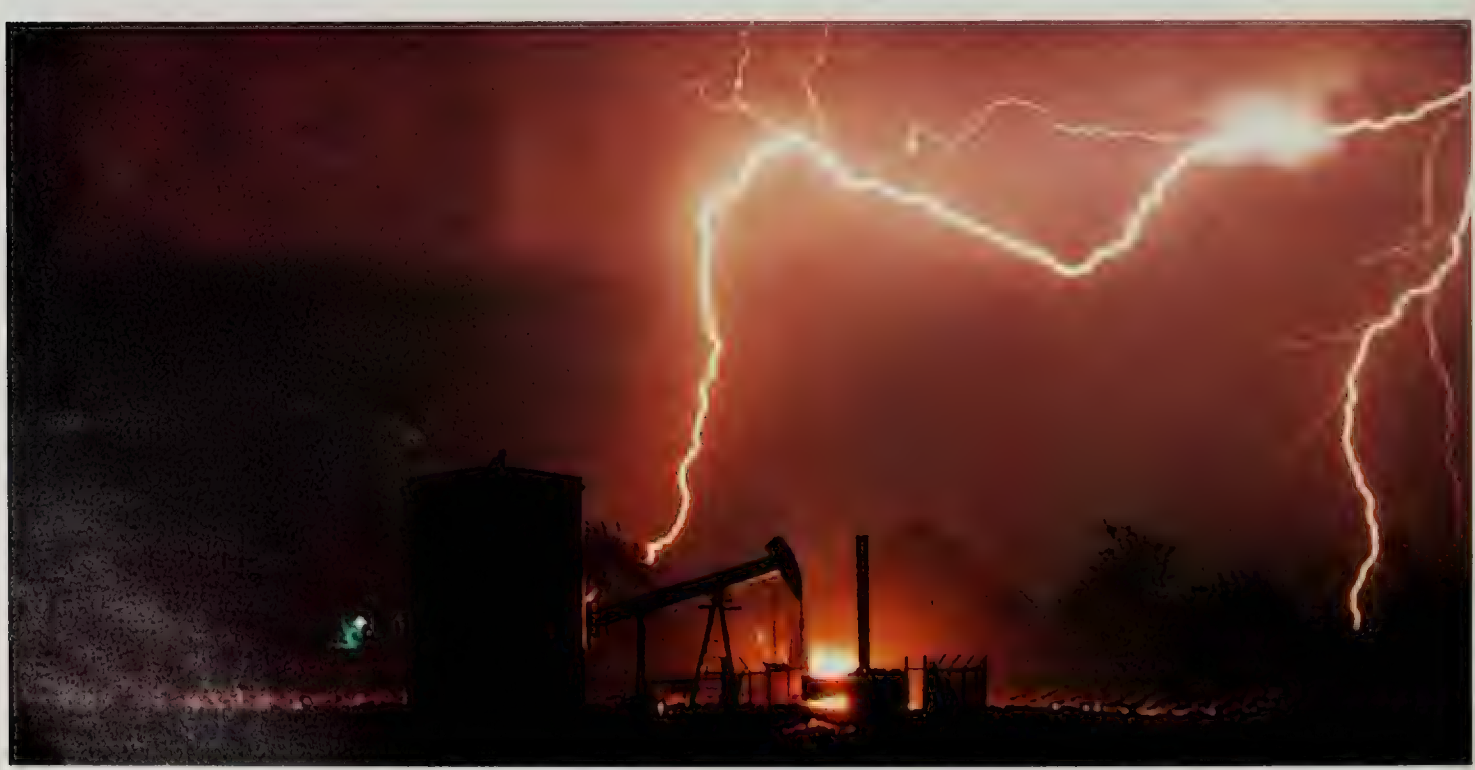
"There are six billion barrels of oil in known Illinois fields. But how do you get at it, how do you find it, and how do you extract it?" Dr. Donald Oltz, head of the Survey's Oil and Gas Section, asked geologists at a seminar in New Harmony, Indiana, last May. The answer, Oltz said, "is dependent upon our understanding of reservoir architecture." Using a series of computer-generated slides, Oltz and his colleague, Stephen Whitaker, explained how the Survey is mapping the Illinois Basin, using core samples and well logs to discern subterranean topography, identify untapped oil reservoirs, and find new ways to recover existing oil deposits.

The oil industry in Illinois is dependent upon technology, Oltz said, and the ISGS can be of enormous help to independent operators in identifying and testing new applications, and in developing new technologies specifically for Illinois oil producers.

Some of that new technology is in the hands of Survey geologists today. Working at Silicon Graphics computer workstations in the ISGS lab, geologists are now able to manipulate data on the lithology and porosity of rock strata in the basin, and, by using a three-dimensional grid, identify potential oil reservoirs. Another new apparatus that will make a difference in oil recovery in the basin is the PVT (pressure, volume, temperature). Under laboratory conditions, the PVT duplicates the pressurized conditions inside an oil reservoir. According to a recent Survey bulletin, "When oil is brought to the surface, a change of pressure, volume, and temperature causes some oil loss in the form of gas. The ISGS can help oil producers calculate this loss with PVT equipment, which measures the decrease in the volume of oil as it comes to the surface and the amount of gas released to the surface."

Talking to his audience at New Harmony, Oltz said the key to making oil recovery efforts in Illinois pay off is twofold: "First we must understand the internal architecture of the Illinois reservoirs, and then we must develop an effective program to manage them." After the studies are completed, the technology must be transfered to the oil producers.

Although the economics of oil recovery in the state haven't been encouraging, oil producers still have an insatiable hunger for knowledge about the basin. Last



Lightning over the Mattoon oil fields. One of Illinois' older oil fields, Mattoon was among the leaders in oil production during World War II.

A towering drill rig holds the enormous drill shaft in a vertical position so it can penetrate deep into the earth.

November when the Survey conducted the first of its technology-transfer sessions, more than 150 southern Illinois independents came to Mount Vernon to find out what the ISGS could tell them about their oil fields. Chief among their concerns were the immediate results of a two-year Survey field study in the basin, an intensive research effort funded by the U.S. Department of Energy and the state of Illinois. The study enabled the Survey to stratigraphically map 15 distinct Illinois oil fields, amassing an enormous amount of data on the oil-bearing strata in the Cypress and Aux Vases formations.

But expensive studies and high-tech oil recovery schemes make many independents skittish, and convincing them to change the way they think about oil production in the Illinois Basin won't be easy. As more than one observer in the industry has noted, "They aren't called independents for nothing."

Future Soundings

On Whitaker's office wall in the Oil and Gas Section of the Illinois State Geological Survey, the following words are posted: "We're not running out of oil—we're running out of ideas." Fortunately for the state's oil industry, Whitaker is full of ideas on where and how to look for petroleum in the state.

One thing is certain, Whitaker told fellow scientists at the petroleum seminar in New Harmony last May, no matter what happens in the Illinois oil fields, the demand for cheap, environmentally safe fuel is unlikely to diminish over the next 50 years. "There's going to be a big demand for oil," Whitaker said, "and it's going to come most economically from domestic sources."

Oil reserves in Illinois and the nation are dwindling, however. While the United States has more oil wells in production than any other nation, these wells produce the least petroleum, a scenario that Whitaker said helped chase the major oil companies out of the Illinois Basin. They needn't have fled. According to Whitaker, they needed to dig a little deeper.

"There's still a lot of good oil-producing potential in the Illinois Basin, and it is up to us to take advantage of it," Whitaker said, sounding a bit more upbeat. "But," he quickly qualified, "we can't keep looking in mature areas using old technologies, old ideas. All the easy oil has been found."

One key to solving the oil puzzle in Illinois is new technology. The other is new thinking. Typically, when seeking out new drill sites, oil producers have looked for certain landmarks in the subsurface topography, usually anticlines, the domed structures called "hickeys" in the field. But the days of finding a hickey and drilling it are pretty much gone, Whitaker says. "Petroleum geologists should be looking at older strata, studying the basin stratigraphy to determine where to look for isolated pools of oil. "A paleovalley network stretches across the entire basin," Whitaker says. "There's no reason that isolated sandstone reservoirs couldn't exist somewhere in these valleys. They do not need to be on structural highs."

Oil producers need to be encouraged to drill deeper into the basin, Whitaker says. "The deepest production well in the state is about 5,200 feet. That's incredibly shallow. In most places people are drilling to depths of 19,000 and 20,000 feet. If there are to be any dinosaurs or elephants found in Illinois, that's where they're going to have to be."

Most of the oil production in Illinois has been pumped from the Pennsylvanian and Mississippian strata, primarily limestone and sandstone beds above a depth of about 3,000 feet. No deposits have been discovered below the Trenton-Ordovician strata, leading some to believe there is little oil to be found below 5,000.* In the mid-sixties, Texaco sank two exploratory wells in the Illinois Basin to depths of 13,000, but in neither case was oil found below 4,000 feet.

But that shouldn't be discouraging, says Whitaker, a man who sees the basin as two-thirds full when others see it as two-thirds empty. "We need to find ways to encourage more drilling to these deeper horizons. The deepest well in the state is only 15,000 feet, and that leaves 8,000 feet of rock we've never seen with a drill bit."

Whitaker's optimism perpetuates a long-standing tradition at the Survey. In 1906, one of his Survey predecessors put it this way: "It is not safe for anyone to say with emphasis that neither gas nor oil will be found in any locality simply because a few shallow bores have proven barren. In Illinois, where oil and gas occur in isolated pools and in several different rock formations, no man can say with certainty what the drill will reveal." ■

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*New evidence may suggest otherwise. The ISGS recently analyzed oil samples recovered in the drilling of a 7,900-foot well. See The Nature of Illinois, Spring/Summer 1992, p [illegible]

William Furry is a regular [illegible] *The Nature of Illinois an*[illegible] *editor of The Illinois Ti*[illegible]

Photos by Joel Dev[illegible]

ILLINOIS BALD EAGLES

by Peter Friederici

Adult bald eagle in flight (Photo © by Richard Day)

In the winter when the northern waters freeze over and the Mississippi seems the only moving thing in a colorless landscape of ice and snow and frozen mud, the eagles come south to fish in the glissading river and roost in the big cottonwoods that line the shore. From a mile away you can see their white heads and tails gleaming in the sun—a flawless white that some settlers called "balde," several centuries ago, all the brighter for its juxtaposition with the somber, dark brown body feathers.

"I Want to See Eagles"

And this is exactly what has brought a crowd of people outside on this sunny, mild February weekend. There's an eagle perched upstream in a tree on Credit Island, just below the last buildings of the Quad Cities. There's another one to the south where the Rock River flows into the Mississippi. Here on the concrete boat landing at Sunset Park, there are about 15 humans for every eagle.

They stare through spotting scopes and binoculars. Adults point the eagles out to children. They take pictures in which the eagles will be visible only as tiny specks. Some have driven for hours to get here. Some are residents of the Quad Cities who have just never paid much attention to the eagles before. Some watch the nearby mallards squabbling for bread crumbs. And some don't.

"I pointed out the ducks to one woman," says Laura Jackson, one of the interpreters for the Quad City event, "and she said, 'I didn't drive all this way to see ducks. I want to see eagles!'"

The big birds are the big draw during the seventh annual Bald Eagle Appreciation Days here in Rock Island, and Jackson has a constant stream of visitors to talk to. All day long she will be describing scenes like this: "In your mind's eye, you expect to see them come up with trout-size fish. So you watch them with their talons in the water, but instead of coming out with a big fish, they catch these little gizzard shad, and they just flip their talons toward their beaks and eat them on the wing."

⁂

The bald eagle exists not alone, but rather as the keystone of an entire ecosystem.

⁂

With a wingspan of up to seven feet, bald eagles are hard to miss. Hundreds of them winter along the big river every year between Minneapolis and St. Louis. Their abundance is overlooked by most Illinoisans, but it is one of the great success stories of the modern conservation movement, since eagles were in danger of being wiped out in the lower 48 states only a few decades ago.

To ornithologists, the bald eagle is *Haliaeetus leucocephalus*, or "white-headed sea eagle," but the hallmark white plumage on head and tail is acquired only after four to five years in dark brown juvenile plumage. To Americans, the eagle is the national emblem, the symbol of all that is proud and free. (Ben Franklin pointed out—in lobbying to make the wild turkey the nation's symbol—that the bald eagle often earns its food by robbing other birds or eating carrion, and he speculated on what such a symbol might say about the national character. We have, for the most part, wisely given up moralizing about the habits of wild animals.)

The eagles that winter along the Mississippi, nest along lakes and rivers from Wisconsin to Ontario and Minnesota. They migrate south to find open water and abundant fish. This past winter, there were close to two thousand eagles on the Illinois and Mississippi rivers between the Wisconsin line and southern Illinois, along with a few more on lakes and reservoirs—the greatest concentration in the continental United States.

Bald eagles benefitted when the Army Corps of Engineers corralled the Mississippi with a series of dams early in this century, since the water immediately downstream of the dams is turbulent enough to remain open in even the coldest winter. The churning stuns small fish, which rise to the surface to be picked up by low-flying eagles.

Some eagles fish directly from the ice shelves that extend over the water—and though some, like Franklin, might think this is a sign of laziness, it is really an indication that the eagles are on a tight energy budget. They need all the calories they can get in order to stay warm through the freezing nights. Hence they are highly susceptible to human disturbance. Eagles do not like humans nearby, and if they are bothered too much during cold weather, they will not survive. They like to roost in big old trees, and need large tracts of riverside forest in which to find shelter both from people and from cold winds.

Learning About the Big Birds

Educating the public about eagles has become a growth industry along the Mississippi. For the last seven years, the Army Corps of Engineers, Illinois Department of Conservation, and Iowa Department of Natural Resources have sponsored Bald Eagle Appreciation Days festivals in the Quad Cities and several other locations.

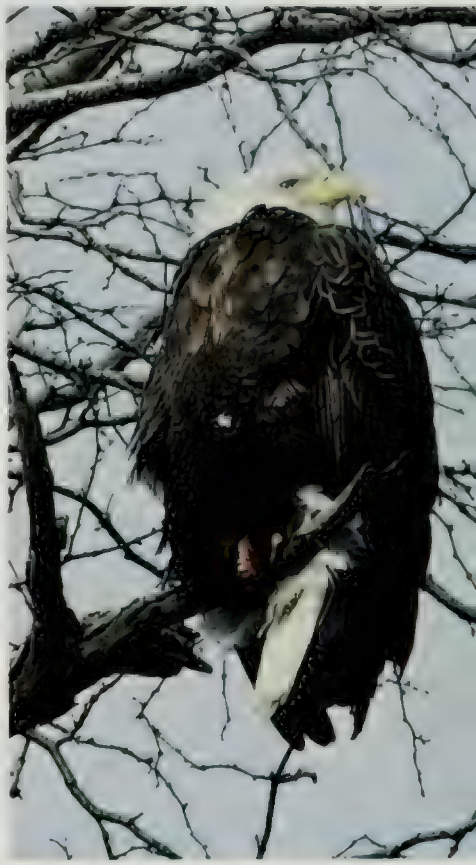
Immature bald eagle (Photo © by Richard Day)

The Quad Cities event took place on the weekend of February 1 and 2 this year in Rock Island. More than 12,000 visitors came to see the indoor environmental fair and wildlife art show that complemented the real-life views at the riverside viewing sites.

The activities were varied. There was a very popular slide show and lecture featuring live eagles and a peregrine falcon. The Army Corps of Engineers was there, passing out free copies of "Our National Bird: The American Eagle Coloring and Fun Book." The Modern Woodmen of America painted eagle heads and Mutant Ninja Turtles on children's faces. The Iowa-Illinois Gas and Electric Company showed off a natural-gas-powered service truck. The Illinois Department of Conservation (DOC) promoted its Natural Heritage Program, which protects unspoiled areas. Message: The bald eagle exists not alone, but rather as the keystone of an entire ecosystem.

"The bald eagle is one of the most majestic, and one of the largest, of Illinois' threatened and endangered bird species," says Patti Malmborg, an Illinois Natural History Survey (INHS) ornithologist who has done fieldwork on eagles. "Because the bald eagle is the national symbol, it effectively dramatizes a success story where man has intervened to save a species from the brink of extinction."

Bald Eagle Appreciation Days—like the Illinois and Iowa nongame wildlife programs promoted here—is dedicated to the proposition that even an animal for which humans can find no practical economic use is worth protecting. (Ironically, interest in eagles is great enough that the birds have become part of the Quad Cities' economy. Mark Beorkrem, executive director of the Quad Cities Conservation Alliance, which operates the convention hall where the expo



Adult bald eagle (Photo by Karl Emendorfer)

took place, estimates that more than 20% of expo visitors are from out-of-town, bringing their tourist dollars to local motels, restaurants, and stores. The money raised at the expo itself was donated to the reintroduction of endangered peregrine falcons in the Quad Cities this year.)

Protecting our National Symbol

Bald eagles would not be seen in Rock Island were it not for the efforts of conservationists. Until the 1940s, the greatest threats to the big predators came from habitat destruction—the big waterside trees that eagles like to roost and nest in, for example, were coveted by lumber companies in many areas—and from shooting. A 1940 federal law, making it a crime to harm the national symbol, was required before widespread shooting stopped.

Other, more [illegible] followed, as documented by INHS population counts. Wildlife biologist Frank Bellrose had been conducting annual aerial surveys of waterfowl wintering on the Illinois and

Fishing on the Mississippi (Photo by Karl Emendorfer)

Mississippi rivers since the late 1940s. In 1957 he began counting eagles.

Bellrose's work, along with the annual counts conducted by amateur birder Elton Fawks of East Moline, revealed low percentages of immature birds. That was alarming, because it seemed to indicate that the eagles were having trouble reproducing.

Researchers eventually figured out that bald eagles, as well as several other raptor species, were receiving large doses of the insecticide DDT. The chemical was sprayed on fields, and when it ran off, it ended up in the bodies of fish eaten by birds of prey. The chemical thinned the eggshells, causing them to break before the young could successfully hatch. The population database established by INHS and Fawks helped lead to the nationwide ban on DDT in 1972. (The pesticide is still made in the U.S. for sale in other countries.)

But Bellrose found that DDT wasn't the only threat. In the 1950s he conducted a comprehensive study showing the devastating effects of lead poisoning on waterfowl. Millions of ducks and geese died every year after they were wounded, but not killed outright, with lead shotgun pellets, or after they ingested spent pellets while feeding. Eagles that ate the waterfowl died, too.

Bellrose's work led to a long and tortuous national campaign against the use of lead shot; the 1991-92 hunting season was the first in which lead shot was banned nationwide in waterfowl hunting areas—which shows how long it can take for compelling scientific research to yield practical results.

The recovery of the bald eagle from poisoning can be traced in INHS statistics, which have shown a steady rise in the number of eagles wintering in Illinois. A comfortable 30% or so are immatures, indicating successful breeding.

Best of all, eagles are nesting in Illinois again. "We think there are 11 nests being used by breeding birds this year," says Sue Lauzon, executive director of the Illinois Endangered Species Protection Board—up from none in the 1960s and 1970s. "It's going up steadily. It seems that every year we learn of a new nest."

The bans on chemical threats, along with public education and habitat protection, may result in the eagle's downlisting from federally "endangered" to "threatened" in a few years. In Illinois, the DOC and private groups such as The Nature Conservancy have bought and protected a number of favored winter daytime and nighttime roosting areas, notably near the Quad Cities and Keokuk, Iowa, where the greatest concentrations of wintering eagles are found. INHS has also worked on a mitigation project to replace a bald eagle daytime roost that was destroyed by highway construction. Malmborg says eagles can be observed roosting from October through March on modified telephone poles that the Departments of Transportation and Conservation installed near a Mississippi River bridge between Keokuk and Hamilton, Illinois.

One of the most important roosts is just upstream from the Quad Cities and south of Lock and Dam 14. The Elton E. Fawks Bald Eagle Refuge was dedicated as an Illinois Nature Preserve in 1989; its 173 acres of forested ravines shelter up to 120 eagles on some winter nights.

In the late afternoon, after spending the day at the expo, I went for a walk in the blufftop park next to the refuge. Sunshine slanted through the leafless oaks. Chickadees buzzed and I heard the distinctive loud churring of red-bellied woodpeckers. I crunched through dry leaves until I stood looking east over a steep ravine. And there, to my left, I saw a large bird perched high in an oak. It was an adult eagle, less than a hundred yards away.

One of the prime eagle facts taught at the environmental fair was: Stay away! Eagles do not like human company. I had blundered closer than I should have.

The eagle stayed put. So did I. But I could not resist the temptation to see it in greater detail. I lifted my binoculars, and just as I brought the lenses up, the eagle flew. It took off and headed south past me into the ravine. It looked oddly symmetrical, with dark body and wings, white head and tail, bright yellow bill and legs. It flapped past on huge wings, not gliding at all, but unhurried, "gazing, calm and slow," as the pioneer ornithologist Alexander Wilson had described the flight of eagles. And when it was out of sight, the woods seemed quiet but also full of hidden life. ■

For information on dates for Bald Eagle Appreciation Days in 1993, call the Department of Conservation's Division of Natural Heritage at (217) 785-8774

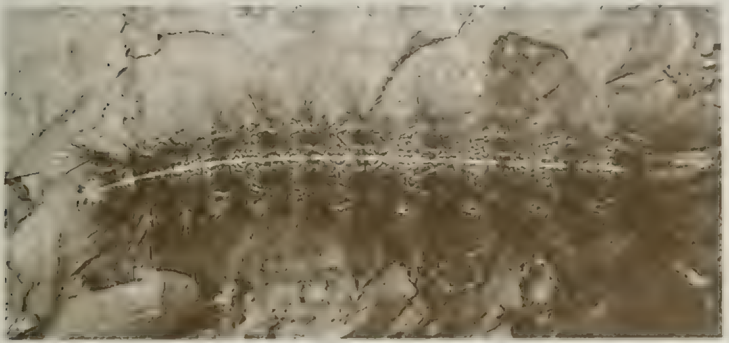
Peter Friederici watches for eagles from his home near Chicago, where he works as a freelance writer and editor specializing in natural history and conservation.

SURVEYING ILLINOIS

BIORHYTHMS

Illinois Natural History Survey (INHS)

A SURVEY OF EDUCATIONAL MATERIALS



Gypsy moth

Legacy of a Pest

This popular middle school science guide—with the formidable title *Legacy of a Pest: A Science, Technology, and Society Curriculum Guide for Understanding and Dealing with Biological Problems*—explores a biological problem and its impact on society and the environment. *Legacy* introduces the fascinating world of entomology, demonstrates why and how one insect, the gypsy moth, can have a profound effect on the urban and natural forest environment, and suggests how the effects of the gypsy moth can be minimized through sound management practices. The principles of thoughtful decision-making stressed are applicable to a wide range of environmental, economic, and social problems.

The curriculum guide includes more than 50 activities suitable for nature centers, park districts, and other settings that offer formal and informal environmental and science education. The guide and a poster of the life cycle of the gypsy moth are $5.00. Teacher workshops on these and other materials may be scheduled by calling Dr. Michael R. Jeffords at (217) 333-5986. Materials are provided free of charge to workshop participants.

Revamped Survey _Reports_

This long-time publication of the INHS comes out six times a year. It has doubled in size and, in addition to summaries of Survey research, includes two new features: "Species Spotlight," highlights of a particularly interesting or important Illinois organism, and "The Naturalist's Apprentice," classroom activities concerning the biological resources of Illinois for middle school science teachers.

Posters—With a Difference

- A 17" x 22" Biodiversity poster illustrating more than 60 plants and animals native to Illinois is available for 15 cents; classroom sets of 30 (with an identification key) are $3.50.
- A new 22" x 24" poster, *Illinois' Living Alphabet*, depicts 26 organisms native to Illinois, from the Alligator snapping turtle to the Zebra swallowtail. It is accompanied by a teacher workbook with descriptions of the organisms pictured and suggestions for related classroom activities. Posters with a workbook are 50 cents; classroom sets of 30 with one workbook are $10.00.
- A set of six black-and-white 11" x 17" posters include: *Trees of Illinois, Illinois Forests, Making Tracks, Family Tree of Insects, Illinois Wildflowers*, and *Illinois Fishes*. Each set comes with study questions (and answers) designed to raise student interest and lead toward a better understanding of natural processes. Individual sets are 25 cents; classroom sets of 30 are $7.00.

All posters are suitable for coloring and are appropriate for elementary and junior high science classes and such other environment-oriented groups as 4-H clubs, scouts, and nature centers.

New Curriculum On the Way

Two new science curricula have been developed, *Biodiversity in Illinois: Activities for Young People*, and *Midwestern Wetlands. Biodiversity* has an optional slide set of 40 images, designed to be used as an introduction to the materials and as part of several of the exercises. The wetlands materials includes a large coloring poster depicting a typical wetland habitat as well as a slide set. *Note: To order any of the above materials, write to: Distribution Center, Natural History Survey, 607 East Peabody Drive, Champaign, IL 61820*

CURRENTS
Illinois State Water Survey (ISWS)

Before the installation of lunkers and the planting of native vegetation, streambanks in Powell Park were severely eroded. (ISWS photo)

ISWS Project Benefits Fish and Landowners

Urban streams are among our most neglected natural resources, according to Water Survey researcher Don Roseboom. Mushrooming housing sites, industrial development, and parking lots leave increasingly less surface to absorb floodwaters, threatening basements, foundations, and parks. Some communities have constructed concrete stream channels to move floodwater faster downstream, but this solution is not only unsightly and expensive, it can cause streambank erosion.

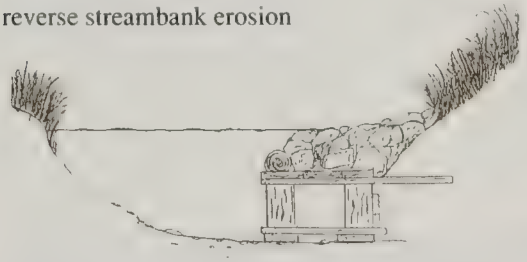
A Water Survey pilot project funded by the Illinois Department of Conservation uses stream *bioengineering* to reverse streambank erosion and loss of habitat. Completed in 1991, the project used "lunkers" (bank cover constructed from oak planks) and the planting of native vegetation at and beyond the stream banks. The results were the doubling of sport fish numbers along a 300-foot stretch of Franklin Creek near Dixon, the stabilization of streambanks, and the control of erosion over a longer stretch of the creek.

Stream bioengineering has been expanded to two urban stream renovation projects in the city parks of Waukegan and in Glen Ellyn in DuPage County. In Glen Ellyn, lunkers made from recycled plastic planks provide below-water habitat for fish while stabilizing the underwater segment of eroding banks. Where the lunkers meet the stream bank, 18" lengths of willows were planted. Larger rooted stocks of red twig dogwood were planted along the bank above the willows, and grasses were planted between the dogwood and the surrounding lawns.

In wooded areas, streamsides were cleared of undesirable exotic species which crowded out many of the native species. Since the invaders have very shallow root systems, the stream channel undercut the non-native species, washing them downstream where they would cause stream blockage.

The DuPage lunker project cost $130,000 and was funded by the DuPage County Department of Environmental Concerns. Extension of a concrete channel through the one-mile reach covered by the project would have cost over one million dollars. And while concrete channels may divert floodwaters from surrounding lands and building foundations, they do not enhance property values nor do they provide habitat for fish.

The project has been extended to Powell and Washington parks where the city of Waukegan, the Illinois EPA, and Region V of the USEPA have funded a pollution prevention program to reduce the flow of urban pollutants into Lake Michigan, protect park lands from increased channel erosion, and provide habitat for gamefish in the Waukegan River.



Lunkers act as bank cover for gamefish while stabilizing the eroding bank.

Groundwater Levels Up in Cook County

Groundwater levels have risen phenomenally in portions of Cook and Lake Counties that have abandoned pumping and switched to Lake Michigan for their water supplies. Since the last mass measurements were taken in 1985, groundwater levels have recovered an average of 73.3 feet (12.2 feet per year).

Current measurements were taken between October 1991 and March 1992. Survey staff measured water levels in 558 municipal and industrial supply wells in northeastern Illinois.

Despite these encouraging findings, there is still need for concern about groundwater levels, according to project coordinator Adrian Visocky. "In 1860, when groundwater pumping first began in the area, the water level was above ground level. Now it's 200 feet below sea level in some areas. That's a drop of nearly 1,000 feet."

Mass measurements began in 1959 when it became evident that the regional aquifer was being overpumped. Water levels were dropping as much as 10 to 15 feet per year in the major pumping centers of Cook, Will, and DuPage counties.

Groundwater is still being overpumped in many areas that have not yet switched to Lake Michigan water, and levels continue to drop. The most serious declines are occurring in Will County near Joliet, where current average water levels are 48.3 feet below 1985 levels, an average drop of 8.0 feet per year. Because the resource continues to be overpumped, the Water Survey will continue monitoring.

GEOGRAMS
Illinois State Geological Survey (ISGS)

Great Guides for Geology Buffs

Illinois is one of the best regions in the world for collecting fossils of plants that flourished more than 280 million years ago. A valuable handbook for learning more about these fossils is the **Guide to Pennsylvanian Fossil Plants of Illinois**, by James R. Jennings, 75p., $2.75. This pocket-sized field guide contains more than 100 illustrated specimens of what the amateur will discover in the field and lists 50 places where Pennsylvanian fossil flora can be found. Also helpful are the glossary and general information on fossil collecting, tools and equipment, and handling and storing specimens.

Two other easy-to-follow publications are the **Guide for Beginning Fossil Hunters**, and the **Guide to Rocks and Minerals of Illinois**, $2.00 each. A good basic map of Illinois is available for $3.00 from the ISGS. It is by H.B. Willman et al, 1959, reprinted 1992; scale, 1:5000,000; overall size: 40" x 56".

You may order publications by mail from The Illinois State Geological Survey, 615 East Peabody Drive, Champaign, IL 61820 or phone (217) 333-4747.

Clean Energy from Coal a Burning Issue at ISGS

Coal research programs are a top priority at the Geological Survey due, in part, to the 1990 Clean Air Act and acid-rain reduction mandates that restrict sulfur emissions. The threat of unusable natural resources, closed mines, and lost jobs— coupled with the national goal of decreasing dependency on foreign energy sources— is being met with a cluster of ISGS programs that aim to make economic sense out of the 50 billion tons of bituminous high sulfur Illinois coal that has great potential for development.

Through the **Illinois Basin Coal Sample Program**, established in 1983, the ISGS provides representative samples of Illinois coals to scientists and engineers worldwide in sizes large enough to satisfy applied research needs. This brings our state the benefit of a wide range of creative research on Illinois coal and, because consistency among coal samples provided through this program is assured, results can be compared with confidence among laboratories around the world.

A **High Sulfur Area (HSA) Hydrated Lime** process (patents pending) is an example of strides being made in the development of cost-effective sorbents to clean up stack emissions generated by the combustion of high sulfur coals. Second to none in nationwide tests of dry scrubber systems, HSA hydrated lime has achieved superior results over other hydrates tested (up to 90% removal of sulfur-dioxide from stack gas).

Looking down into a column floatation device

Fine Coal Cleaning techniques, developed by the ISGS, provide improved methods for cleaning and marketing coal "fines" which are virtually unusable because of their small particle size. Techniques for recovering fine coal—approximately 5% of the state's annual coal production—were tested in the ISGS laboratories with positive results and confirmed in commercial tests with Kerr-McGee Corporation and the Deister Concentrator Company. Success will not only decrease the amount of waste coal which is disposed of on the land, but also extend coal resources and improve the economics of coal production.

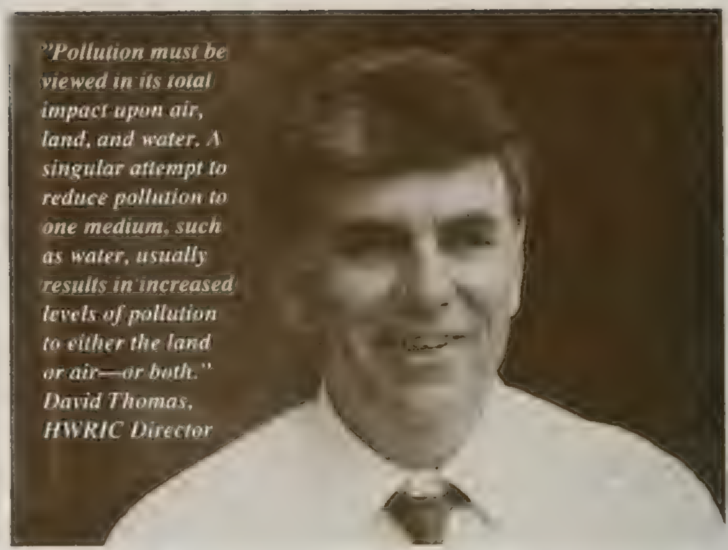
The Illinois Department of Energy and Natural Resources and ISGS have been instrumental in initiating tests of **Gasification**, a process which uses the cleaned coal fines. Gasification produces more power with less waste and, as an added benefit, the sulfur and slag by-products can be marketed commercially.

Another innovation, **Pelletization**, improves the marketability of cleaned fines through particle enlargement. Two approaches have been developed: one uses lime, both as a binder and a sulfur absorbent; the other uses waste biological materials (municipal waste or lignin from wood, corn, or paper) as a binder and as a renewable, low-sulfur addition to the coal. This is a joint project of the ISGS, the University of Illinois Forestry Department, the U.S. Army Corps of Engineers, and the Tennessee Valley Authority.

The ISGS is also examining: (1) the development of premium liquids from coal (which has a potential to replace a portion of imported petroleum crude oil); (2) the development of clean coal solids for use in coal-fired Diesel engines and gas turbines; and (3) the development of carbon products that will function as molecular sieves and catalysts to purify the air and water, aid in the decomposition of toxic chemicals, and produce new chemicals.

"These research and development activities of the ISGS," emphasizes John Lytle, head of the Minerals Engineering Section of the ISGS, "continue a long tradition of bringing science and industry together to create jobs in Illinois."

ISGS coal research programs have been funded by the Illinois Department of Energy and Natural Resources through the Illinois Coal Development Board and the Center for Research on Sulfur in Coal.



"Pollution must be viewed in its total impact upon air, land, and water. A singular attempt to reduce pollution to one medium, such as water, usually results in increased levels of pollution to either the land or air—or both." David Thomas, HWRIC Director

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

Helping Industry Go For the Green

Sound waste management is more than a benefit to the environment—it is cost-effective.

Pollution prevention is fast becoming a number one priority of the USEPA and a way of doing business for many forward-looking companies. The subject was explored at a workshop at the Chicagoland Chamber of Commerce last May, where three industry spokespersons made strong cases to local businesses for "going green."

This was an important step, according to HWRIC Director David Thomas, in promoting pollution **prevention** to Chicago area industries in cooperation with the USEPA, Illinois EPA, and Metropolitan Water Reclamation District of Greater Chicago. The purpose of the gathering was to discuss challenges, share success stories, and make the point that sound waste management goes beyond finding the shortest route to a safe landfill. It was also an opportunity to update the status of government pollution prevention planning and make companies more aware of HWRIC's services.

"Good experiences" were presented by Mobil Oil, Abbott Labs, and Caterpillar, Inc. According to Pam Posster, senior environmental engineer at Mobil's Joliet Refinery, her company's pollution program began as a grass roots effort that led to impressive reductions in both the quantity and toxicity of waste in 1991. "We're recycling, reusing, recovering—keeping waste out of the landfills. We tackled the easy-to-accomplish problems first," Posster says, "and now we're eyeing the more technically difficult ones."

HWRIC's Assistant Director Gary Miller agreed that some problems are so technically complex and the manufacturing process so fine-tuned that it's no trivial matter to rethink and retool. "It is through the combined efforts of us all that solutions to difficult problems will evolve."

"It's a good rule of thumb that it's 20 times more efficient to prevent waste than to dispose of it afterward." "Most programs pay for themselves within a year and sometimes there's not even a cost involved—just creative thinking." Gary Miller, HWRIC Assistant Director

The success stories—pollution prevention techniques and initiatives—will be published by HWRIC, added to its information clearinghouse, and available to business and industry around the state. The information will also become part of a worldwide computer network being developed by HWRIC, USEPA, and the United Nations.

The goal for the Greater Chicago Area project outlined at the Chamber of Commerce luncheon is to reach generators of waste through the Water Reclamation's pretreatment program and offer them technical assistance, training, and guidance for voluntary planning. A fall workshop has been scheduled for the electroplating industry, and several other Chicago area audiences will be targeted, such as large companies that are out of compliance with wastewater regulations; the heavily industrialized southeast Chicago area; and toxic release emitters. (Since 1988, the USEPA has required large generators to report emissions of 300 listed chemicals; 64% of all Illinois emissions are in the Chicago Metropolitan area.)

"Pollution prevention involves the flow of materials through facilities and the reduction of waste to all media—land, air and water," says Thomas. It involves making "cleaner" products, ones that last longer and/or are easier to recycle and reuse. The concept of "green" products is important and many companies are finding a growing market for environmentally friendly products. To be effective, pollution prevention should be incorporated into business practices from product design through the manufacturing and packaging processes.

The Illinois Manufacturers Association (IMA) and the Illinois State Chamber of Commerce are investigating the potential for pollution prevention programs among their memberships, and HWRIC is surveying IMA members to determine their needs for information and technology.

For more information on the Greater Chicago Pollution Prevention Strategy, contact HWRIC, One Hazelwood Drive, Champaign, IL 61820, (217) 333-8940.

TEACHING THE NEW 3-RS

Bill Steinbacher-Kemp

> *"I am proud of the way that ENR's solid waste management education program is helping young people make a lifelong commitment to reduce waste and promote recycling. Our activity packet for teachers and other materials are providing educators with resources that increase student awareness of landfill problems and the need to adopt the 'reduce, reuse, recycle' philosophy. We are pleased with the reports we have received that students are applying what they learn both at home and in their schools."*
>
> John S. Moore, Director
> Illinois Department of Energy
> and Natural Resources (ENR)

SOURCE
REDUCTION
ENR
WASTE REDUCTION
EDUCATION
RECYCLE
REUSE

ENR Director Moore distributes information to students at the Ridgley School in Springfield and talks to them about practicing sound waste reduction and recycling methods. (ENR photo by Tom Hecht)

From Maplewood Elementary School in McHenry County to Alton Senior High School in downstate Madison County, students throughout Illinois are learning the three Rs of environmentally sound solid waste management: reduce, reuse, recycle.

Pat Dieckhoff, recycling coordinator for McHenry County, says that she works with recycling coordinators in each of her county's 71 public and private schools to create programs designed to engage the interest of students. Students at the Montessori school in Crystal Lake, for example, compost their food waste. After lunch each day, sixth-grade students collect leftovers, such as uneaten sandwich bread and apple cores, take them to the compost pile, and turn the mix over to promote decomposition. "It's just another way of recycling," says Dieckhoff.

Last February, Maplewood Elementary School held a "no paper day," during which students avoided the use of paper. Teachers used chalkboards and overhead projectors, and some students even used small chalkboards at their desks. The event helped raise awareness of wasteful habits, such as using only one side of a page for scratch paper, according to Diekhoff. Since "no paper day," the school has reduced its paper waste from seven bags a day to three.

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The object is not just to recycle, but to decrease the amount of waste generated in the first place.

⁂

District 200, in the McHenry County community of Woodstock, has developed one of the state's most advanced recycling programs, according to Barbara Banker, the district's community services coordinator. The district's eight schools recycle newspapers, several grades of paper, cardboard, and Styrofoam. A grant from the Illinois Department of Energy and Natural Resources (ENR) allowed the district to purchase storage sheds to store paper before it's hauled away and recycled. "Our recycling efforts are in large part due to the state grant," Banker says.

The district is not only recycling paper but also reducing the amount of waste it generates in the first place. Most of the community's schools use reusable trays and silverware to reduce lunchroom paper and plastic waste. In the two schools that still use Styrofoam trays (they lack kitchens to clean plates and silverware) the trays are stacked, placed in plastic bags, and recycled.

Twenty schools in Madison County near St. Louis are participating in a state solid waste pilot program, according to Ann Linenfelser, recycling education coordinator for the county's solid waste department. Another ENR grant enabled these schools to build storage sheds to house recycled goods until they could be hauled away to recycling centers. Linenfelser also says schools purchased collection carts and bathroom scales to dramatize the fact that for every 120 pounds of paper collected, students save the equivalent of one tree. "We are promoting reuse and reduction as well as recycling," she says.

Linenfelser also travels to Madison County classrooms to teach recycling, individually tailoring lessons for each grade—kindergarten through eighth. She stresses a holistic approach to the solid waste problem, making the connection

These 140 plastic milk jugs have had three lives. First, obviously, to hold milk; second, to serve as construction materials for an igloo for first graders studying Eskimo culture; and finally, off to the recycle bin to begin life anew in some yet-to-be-determined form. (Photo courtesy Mary Kasten, Eastwood Elementary School, East Alton, Illinois.)

between the depletion of the earth's valuable rainforests and the ecologically unsound lifestyles of many Americans.

Last year, schools throughout the state celebrated Illinois Recycling Day by promoting waste-free lunch programs. St. Louis Catholic School in Princeton, for example, handed out "Caught You Being Good" awards to students using waste-free lunches, and many students are now buying reusable lunch bags made of nylon or cotton. Schools in DuPage, Will, and Clinton counties were among those participating in the "Great Balls of Foil" contest last school year, and the makers of Reynolds Wrap gave cash prizes to the schools that recycled the most foil. In another successful program in 1990, the Illinois State Board of Education prevented districts from throwing away 32,000 excess textbooks by distributing them to districts that needed them.

The Illinois General Assembly has passed laws to promote recycling and responsible solid waste management in Illinois schools. The state currently calls on public schools and school districts to purchase recycled paper goods "whenever economically and practically feasible," and requires that, by July 1992, the purchase of recycled paper and paper products must account for at least 10% of a school's paper budget.

Students at the Kenwood School in Champaign go through a step-by-step demonstration to learn how old newspaper is recycled into new paper. The resulting paper product is a 5"x 7" sheet that youngsters can use for other school projects. (Photo courtesy the Community Recycling Center, Champaign, Illinois)

✣

The brown paper bag lunch is no longer ecologically correct. Many students are using reusable lunch bags made of nylon or cotton.

✣

The General Assembly also passed legislation calling on ENR to develop and distribute educational materials on recycling and waste reduction for instructional use. As a result, ENR is a treasure trove of valuable information for schools looking to institute or expand recycling programs.

ENR's "Solid Waste Activity Packet" is crammed with resource materials to help teachers and students understand solid waste issues. Activities ideal for younger students include making crafts from trash, such as constructing bird feeders from plastic milk jugs. "Recycle Our Available Resources (R.O.A.R.)," a guidebook written by Mount Zion Junior High School teacher Donna Johnson, is designed for grades four through eight and includes songs, experiments, recycling facts, and even a puppet-show script. ENR also has dozens of helpful solid waste videos, with titles such as "Down in the Dumps," and "The Rotten Truth." A teacher's guide accompanies the videos.

For information on educational materials from ENR, call the department's information clearinghouse at 1-800-252-8955. ■

Bill Steinbacher-Kemp is a staff writer for Illinois Times, *Springfield's independent weekly.*

Notable Nature Books for Children

The Chicago Public Library's **NatureConnections** project has complied a new list of nature books for children from preschool to grade nine. Bears and bats and dinosaurs, the desert and rainforest, geology and the weather are some of the subjects covered in the 18 recommended books—all well-written, beautifully illustrated, and scientifically sound. For an annotated book list, send a self-addressed stamped envelope to: 1991 Books, The Nature of Illinois Foundation, 208 S. LaSalle St., Suite 1666, Chicago, IL 60604.

RIVER RESEARCHERS

by Sheryl De Vore

On a warm, bright spring day, Glenbrook South High School student Tania Aglikin, dressed in gym shoes and jeans, flings four connected polyvinyl chloride (PVC) zebra mussel monitoring traps into the Des Plaines River in Glenview. Aglikin and thousands more students like her from high schools in Illinois, Iowa, Minnesota, and Wisconsin are performing similar experiments. And that could have a positive impact on our state's river environment, according to Doug Blodgett, assistant research biologist for the Illinois Natural History Survey (INHS). "These students are gaining a greater respect for Illinois rivers," he says, "and they are collecting data that can, in many ways, add to our knowledge of the river system."

Aglikin is participating in the Illinois' Rivers Project, founded two years ago at Southern Illinois University in Edwardsville with eight pilot schools along the Mississippi and lower Illinois rivers. Currently students from 108 schools from Little Falls, Minnesota to Cairo, Illinois are monitoring the Mississippi, the Illinois, and other major rivers in Illinois. The project's "River Watch" network is tied together through SOILED NET, a telecommunication system located at Southern Illinois University in Edwardsville. It involves high school science, social science, and English teachers in an integrated study of their local river and community. The project, which also publishes a student-authored book, *Meanderings*, is directed by SIU professor Dr. Robert Williams and Cindy Bidlack.

The results of student data-collection activities are stored in the SOILED NET data base at SIU and are available to the INHS, U.S. Fish and Wildlife Service, and other river managers. "Tapping into the Illinois' Rivers Project is a cost-effective way to expand our data base and sample more sites more frequently. Blodgett is quick to point out, however, that while this information "adds to the picture" the information collected by the students is entered into the data base with the notation that it has been collected by high school students.

Tania Aglikin, Glenbrook South High School, prepares to set a zebra mussel trap in the Des Plaines River. (Photo by Sheryl De Vore)

Students from Alton Senior High sweep the river in their study of macrobenthic organisms (Photo courtesy of The Illinois' Rivers Project)

Blodgett and INHS scientists are specifically interested in reviewing data the students gather on zebra mussels, non-native species which are clogging Illinois waterways.

The adult European zebra mussel is a one- to two-inch long freshwater mollusk that firmly attaches itself to solid objects such as boats and makes its way along Illinois waterways. Students are monitoring for adults as well as larvae, which can be microscopic and are therefore more difficult to detect.

Scientists believe the zebra mussel came from its native Black and Caspian seas to Europe and then to the United States in the ballast water of a ship. Within two years of its first positive iden-

Students from Alton Senior High conduct tests at Lock and Dam 26 on the Mississippi. (Photo courtesy of The Illinois' Rivers Project)

tification here in 1988, it had infiltrated the Great Lakes and it is now found throughout the Illinois river system. Zebra mussels are prodigious multipliers and pose a multi-billion-dollar threat to industry and public water supplies because they clog water intake pipes, sink navigational aids, suffocate native clams, and foul barge hulls.

When Blodgett met Bidlack and Williams at a river conference two years ago, they talked about working together not only to gather additional information on the spread of the zebra mussel but also to teach students how scientists collect information. INHS scientists had been installing monitoring traps in the rivers, then counting the number of zebra mussels and larvae. Blodgett showed Williams the monitoring traps and; soon after, Williams began to collect scrap PVC material and recycle it into traps patterned after the INHS model. Rivers Project students began placing the traps in Illinois rivers last May.

Some of these data "may provide insight into why the mussels are in one place and not the other," says Blodgett. "Students are learning how fast an exotic species can reproduce and about population growth trends. There are lots of good ecology lessons to be learned."

"They've caused problems already," says Aglikin. "I read about one nuclear electricity plant in Michigan where zebra mussels got stuck in the water pipes for cooling down the reactors. They had to send divers down to scrape them off. It cost hundreds of thousands of dollars."

"To know that what I'm doing could affect science is exciting," says Aglikin, gingerly stepping down the Des Plaines River bank, her arms full with the monitoring device, a long cord, and an empty gallon milk jug. The jug will float in the water and help her locate the traps each time she comes to see if any mussels or their larvae have been attached.

"The program instills in them an understanding of the importance—and the vulnerability—of rivers."

Doug Blodgett, INHS biologist

In addition to mussel collecting, students have been collecting water samples from the river and testing for presence of fecal coliforms, measuring dissolved oxygen levels and ph, and performing other water quality tests. "They are learning that accuracy counts and that things constantly change on the river—there are variables that may make, for instance, the phosphate levels low one day and high the next," says Aglikin's teacher, James Shellard. "Students are beginning to appreciate the volume of data needed to gain some insight into a river system."

"While the Illinois' Rivers Project may open doors for some students to get into science careers, more importantly, it gives them a better appreciation of the river systems and how they work," says Blodgett, who works at the INHS Havana station on a Long-Term Resource Monitoring Program of the Upper Mississippi river system. (See "River Watch," The Nature of Illinois, Winter 1992.) "Students learn how man has impacted the river systems," he says. "The program instills in them an understanding of the importance—and the vulnerability—of rivers. Then they can relay that understanding to others, such as their parents and the community," he says. "And they will always be better citizens and better friends of the environment."

Bidlack can cite stories of how students involved with the river project have observed and minimized human impact on Illinois waterways. For instance, students at Jerseyville High School found unusually high levels of fecal coliforms in a creek running through a small town nearby. They learned that the town's outdated sewage system was contaminating the creek. They talked to community members, wrote letters to health departments and the EPA, and attended town meetings. "They became political activists, and the end result was that within three years each homeowner will be required to install a private sewage system," says Bidlack. "This was hands-on science and hands-on government."

"I know that coming to the river will affect kids who will be doing the project next year just as it has me," says Aglikin. Even though she graduated from high school in June, she plans to teach other budding scientists at Glenbrook South how to perform water-quality tests and how to examine the zebra mussel monitoring plates she placed in the river last spring. ■

*Sheryl De Vore is a free-lance nature and environment writer and a regular contributor to **The Nature of Illinois**.*

EXPLORING THE LANDSCAPE WITH A MASTER STORYTELLER

by Patricia Cronin

Geological field-trippers ignore the discomforts of rain to hunt for geodes at Mill Creek in Pere Marquette State Park. (Photo by Jim Imbrogno)

At the confluence of the Mississippi and Illinois rivers, just southwest of the glacial boundary in western Illinois, lies scenic Pere Marquette State Park. Surface elevations in the area range from 419 to 892 feet above mean sea level. The spectacular Cap au Grès Faulted Flexure, crossing the area from west to east, contributes to the impressive topography. Along this fault, horizontally deposited rock layers were tilted upward by pressures within the earth's crust in the geologic past. The broad Mississippi and Illinois rivers were formed by repeated torrents of water carrying sediments released from the melting Wisconsinan glaciers. Dramatic limestone bluffs along the Great River Road form the eastern and northern sides of the river valleys and provide a rugged vegetated setting. At Grafton, the ancient Mississippi Valley, now occupied by the Illinois River, meets the present-day Mississippi Valley. Terraces are well developed along the valleys, and thick Wisconsinan loess (windblown dust laid down within the last 20,000 years during the last Great Ice Age) mantles the gently rolling uplands in which today's fertile soils formed.

At Mill Creek (Photo by Jim Imbrogno)

David Reinertsen, Educational Extension
Illinois State Geological Survey (ISGS)

On a recent geological field trip to Pere Marquette State Park and surrounding areas in parts of Jersey County, Dave Reinertsen, ISGS field trip leader for more than a quarter of a century, explained to me how he goes about planning the locations. (Since 1929 ISGS has conducted more than 300 free field trips to 194 Illinois locations.)

"I check geological publications for locations of exposures of [illegible] rock formations. I make [illegible] can accommodate a lot of people [illegible]

A stop at an abandoned quarry (Photo by Jim Imbrogno)

I link potential stops together to give participants a chance to explore and discuss different geological phenomena."

"I also figure out the story of the land and give people a feel for the region—why the land is the way it is, how people have lived on the land throughout time, and how they have made their living."

The Story of the Land

I was surrounded on that October day by acres of mown fields, two-lane highways unfurling like ribbons on the rolling landscape, and the surge of determined rivers between rocky outcrops.

Reinertsen told us that the gently rolling uplands of Jersey County had developed on deposits left by two periods of glaciation (the Illinoian and Wisconsinan) which began 300,000 years ago and ended about 12,000 years ago. That gentleness is broken dramatically by scenic bluffs where river erosion had exposed the bedrock that underlies the area.

The handful of small towns that dot the area have a unique blend of familiarity and distinction: specialty stores and antique shops, diners and small inns that thrive on tourism and curiosity, and the stores and services that form the backbone of everyday, working communities. Today, stone (limestone and dolomite) is the only mineral resource produced in Jersey County, but the river systems and the fertile soils that had developed from the loess and alluvial-filled stream valleys brought farming, livestock, orchards, fishing, and freight to the area. Godfrey, Elsah, Grafton, and Alton are towns whose histories and fortunes are a result of their success in working with the very land on which they sit. There's something to be said for walking, if not in someone else's shoes, then on their home turf, especially with a master storyteller. It amounts to a considerably different view than the limited perspective the window of a moving car provides.

Heading Out Over the Land

Our caravan of 40 cars left Pere Marquette State Park, where 150 geological trekkers had convened shortly after 8 a.m. We ignored the heavy mist and intermittent showers in order to hear Reinertsen's tale that day. The overview for the 36 miles we were to cover that day would reveal the influences of glaciers, ancient sea beds, and pressures from inside the earth.

The hill at our first stop was nearly 100 feet above the surrounding area—an excellent view of the countryside and an opportunity to see similar hills to the north. It's the kind of scene I've noticed before, but I had not fully understood that the rolling hills had been sculpted by glaciers within the last million years. They are thought to be part of an old Illinoian end morraine, comprised of drift (rock material transported by a glacier and left behind when the glacier melted) and blanketed by younger wind-blown Wisconsinan loess.

The Importance of Land Literacy

Geological Survey field trips began in 1929 to familiarize teachers with the local landscape and its resources. The geologists hoped that teacher-interest would produce a ripple effect, spreading to students and fellow teachers. In time, the Survey invited rock and mineral clubs on the trips. In the early years, a 14-car caravan was considered a phenomenal turnout; now the 50-car caravan is standard, regardless of whether the weather is fine or foul.

"On a Galena trip some years ago," recounts Reinertsen, "there were close to 500 people. They arrived in 92 cars and five Trailway buses out of Chicago. It was so doggone wet—just difficult to figure out. It must have been too wet to paint or garden," he muses, looking for a reason for such a surprising turnout.

Reinertsen has strong opinions about environmentalism and education. He would like to see the schools teach more earth science.

"Students should have an understanding of earth science before being turned out into the world so that, as voters and consumers, they can make better judgments. Many schools use earth science as a course for students who are steered away from physics, chemistry, or biology. Administrators need to understand what earth science is, what is does, and what it can do. In fact, the field of study requires knowledge of math, chemistry, physics, and biology." He maintains that it should be a "means by which young people learn about the earth, its finite and recyclable resources."

In the late 1600s Pere Marquette described the river bluffs along the Mississippi as "frightful for their height and length." (Photo by Max [illegible])

The Pennsylvanian Colchester Coal Member (315 million years old) underlies the hill and immediate vicinity, but it was eroded away to the west. The erosion, we were told, probably occurred long before the advance of the glaciers.

Hunting for Treasure

Hardhats, safety goggles, and hammers came out at Mill Creek, and the trip's focus shifted from a spectator sport to one of active participation. The activity in the field stirred my senses. I heard the first sounds of loose gravel underfoot and then picks and hammers hitting the rocks. The smell of the wet land rose in the mist. Explorers maneuvered through the shallow water and mud of Mill Creek, trying to keep their balance along the steeply cut eight-foot banks of the stream.

Mill Creek, cutting through Warsaw Shale Formation, is considered good ground for finding geodes. These plain, brownish, imperfect spheres are unlikely treasures. Often the size of a baseball or grapefruit, the most promising geodes are surprisingly lightweight. Upon being cracked open, their nearly hollow centers reveal clusters of sparkling inward-pointing crystals.

The excitement of collecting along the banks of Mill Creek is only one reason for the popularity of these trips. Interest in the formation of the landforms and Reinertsen's proficiency as a storyteller are the other reasons. His recognition of familiar faces reveals his appreciation for those who share his interest in the land, and I catch fragments of conversation

Pere Marquette Lodge (Photo by Jim Imbrogno)

Pere Marquette State Park and Lodge

The centerpiece of Pere Marquette State Park is its historic lodge. Originally built in the 1930s by the Civilian Conservation Corps (CCC), the lodge is a massive study in stone and timber— locally quarried Limestone and western red cedar, Douglas fir, and bald and pecky cyprus shipped in by rail from Oregon. This impressive CCC project also included the planting of 280,000 trees and shrubs about the lodge. The structure is an appropriate manmade balance to nature's handiwork; like the park, the chalet-style lodge is dramatic in its reflection of history and in its scale, with its massive custom-made furniture, chandeliers that weigh a ton or more, a towering 700-ton limestone fireplace, the "world's largest chess set," and bronze fixtures made by a former employee of the Czar of Russia.

Located nearby is the Visitor's Center, a two-story building converted from a corn crib, which houses exhibits detailing the park's history as well as a collection of artifacts found on the park grounds: arrowheads and beads, hand-held hoes, early Indian pottery, and scrapers used for processing animal hides.

Pere Marquette State Park is comprised of lush forest and striking limestone bluffs along the Illinois River. Originally spanning 1,500 acres when first acquired in 1932, the park now extends to nearly 8,000 acres.

Scott Isringhausen, Pere Marquette State Park interpreter, says, "It's a different park with each season—not only in its appearance, but in the activities offered." Visitors can enjoy horseback riding on the park's 14 miles of riding trails, hiking on 12 miles of trails of varying length and degree of difficulty, forest game hunting, and fishing. Innovative park interpretation programs are offered year-round and include a winter eagle watch, a program on bats, and highlights of the three kinds of bluebirds found in the park. A recent talk on edible plants found Isringhausen gathering wild persimmon and baking homemade persimmon cookies for a local Girl Scout troop.

The Pere Marquette Lodge and adjacent campground is situated within one of the state's most beautiful natural settings and close to neighboring towns. This provides a generous array of activities for enthusiasts of all kinds. Collectors can scout the many antique shops in hopes of picking up old treasures, enjoy the various year-round activities within the park itself, or venture off to the Great River Road, a popular trail for hiking and bicycling.

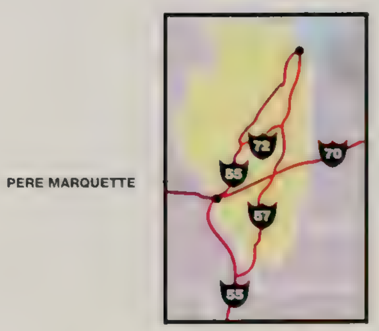
For information on Pere Marquette State Park programs call 618/786-3323. To inquire about lodge accommodations, call 618/786-2331.

people comparing regions, reliving past experiences, retelling anecdotes—all a part of ISGS field trip history.

While most Illinois landforms developed during periods of glaciation, the southern and southwestern parts of the Pere Marquette area fall outside of the glacial boundary, which accounts for the variety of landforms/topography. The outstanding features of the park are as dramatic and striking as the glaciated hills are pastoral.

At the McAdams Peak Shelter House that overlooks the Illinois River and peninsular Calhoun County, we had the best view of the Cap au Grès Faulted Flexure. Rising through the fog, it was visible as a sharp change in elevation along the narrow ridge of sedimentary rock that formed the far river bluffs. Sedimentary rock underlies all of Illinois and is one of nature's finest examples of the recycling process, since some of the rocks (shale and sandstone) are derived from weathering and erosion of pre-existing rocks. Other rocks (limestone and dolomite) are formed from thick accumulations of shell debris. This debris was cemented by the mineral calcite that was chemically precipitated from sea water more than 330 million years ago.

According to Janis Treworgy, another ISGS geologist leading the trip, the Cap au Grès is important because it is exposed and we can see the relationship of the different rock layers. Exposures of faults help us reconstruct the history of the continent, tell us the degree of stress on certain regions, and document that point in time when rocks folded and broke.



The park is a magical place in every season (Photo by Jim Imbrogno)

"The continents and ocean floors behave as rigid 'plates' that are constantly, though imperceptibly, shifting and exerting compressional or tensional stress on each other. This stress causes rocks to fold and/or break, resulting in features like the faulted flexure," says Treworgy.

The Cap au Grès Faulted Flexure—which extends through parts of Lincoln County, Missouri, and southern Calhoun, Jersey, and Madison counties in Illinois—affected the origin and development of landforms in the area. Because water follows the course of least resistance, water drainage in this area developed channels along broken and weakened rocks produced by the faulted flexure. This process took several million years and established the present-day course of the Mississippi and Illinois rivers.

Closer to the center of the park, a trail goes by a rather steeply dipping exposure of limestone. This is the St. Louis Limestone that was formed about 350 million years ago in a shallow sea. The limestone consists of rounded, broken fossil fragments and whole small fossils. The St. Louis and other older limestones and dolomites make up the river bluffs, once described by Pere Marquette as "frightful for their height and length."

My last stop was at the Visitor's Center—comfortably close to my car. My legs ached from hiking the steep inclines and my feet felt like something left over from Precambrian times. Amidst the tangle of bright fall trees, against a backdrop of mist, I stepped a bit more knowingly on the worn path.

I was reminded of a quote by Thomas Carlyle, "The tragedy in life is not what men suffer, but what they miss." I was cold and wet and the owner of two soggy, rain-splattered notebooks. I had learned a thing or two about the state of Illinois, the state called 'home' and I knew this for certain: I wouldn't have missed it for the world. ■

Thanks to David L. Reinertsen and Janis D. Treworgy for assistance in preparing this article for publication. Their Guide to the Geology of the Pere Marquette State Park Area, Jersey County, *is a fine resource for a self-guided tour of the area visited by author Patricia Cronin and her photographer husband Jim Imbrogno. A list of field trips for 1992-93 may be obtained from the Educational Extension Unit, Illinois State Geological Survey, 615 Peabody Drive, Champaign, IL 61820. Telephone: 217/ 244-2407 or 333-7372*

Overlooking the Illinois River and the Stump Lake Waterfowl Management area (Photo by Joel Dexter, ISGS)

THE GEMS OF HANCOCK COUNTY

by Bob Wathen

The rocks lining Irene Schneider's driveway look like those that line thousands of driveways in Illinois, but they are no ordinary Illinois limestone or sandstone. Lined up in rows along her driveway are Hancock County geodes, world famous in geological circles.

For the past 25 years, Schneider has been collecting geodes near her home in the small town of Hamilton. The rows of rounded stones lining both sides of her driveway offer only a hint of what lies in her backyard. There, you will find hundreds of the crystal-filled rocks.

Scott Beaty holds a monster of a geode that has been cut in half and carefully polished to reveal the clear quartz crystals inside.

How Does Her Garden Grow?

Geodes are usually globular hollow stones with an outer shell like a melon. In fact, the word "geode" derives from a Greek word meaning "in the shape of the earth." Inside, they are lined with crystallized minerals that have grown inward. As can be seen from the Schneider's garden, they come in many shapes, colors, and sizes. A small geode might be the size of a walnut and a large one the size of a melon. Besides crystals, geodes may also contain sand, water, or even petroleum. "You never know what you'll find inside," comments Schneider. One of her rarest finds is an oil-filled geode a couple of inches across and broken in two halves. Even though the oil has dried out, a black gooey residue remains. "They are more common south of here, but still rare," she says.

"People in Keokuk (Iowa) call them Keokuk geodes, but we call them Hamilton geodes," says Schneider with a touch of local pride. Geodes can be found all over the world. Here, in far western Illinois, they formed hundreds of millions of years ago on both sides of the Mississippi River in limestone known as the Warsaw Formation. Whether you call them Keokuk or Hamilton or Hancock geodes, in this area you will find not only a remarkable abundance but also a wide variety of geodes, including some that contain very rare minerals.

"You'll hear stories about geodes this big," Schneider says as she stretches her arms as wide as they will go. "Really, the largest one found in this area is only 27 inches across. So there are some exaggerations. It would take a fork lift to move a geode that big," she says, as again she stretches her arms far apart.

Schneider is well-known locally for her extensive collection of geodes. And she proudly displays them in her backyard geode garden. On this day though, about 75 of her best specimens are on display at the Hamilton Public Library.

"I find them all over town. When we moved here 25 years ago, that was a farm field," she says as she points down the street. "I found them right up the street where all those houses are today. Then, I started looking around local rivers and creeks. Stream beds around here are practically paved with geodes. You can find them within about a 70-mile radius. They are really a nuisance in some places, especially in farm fields."

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> **The little environment inside this hard shell is very good for mineral growth.**
>
> Scott Beaty, ISGS

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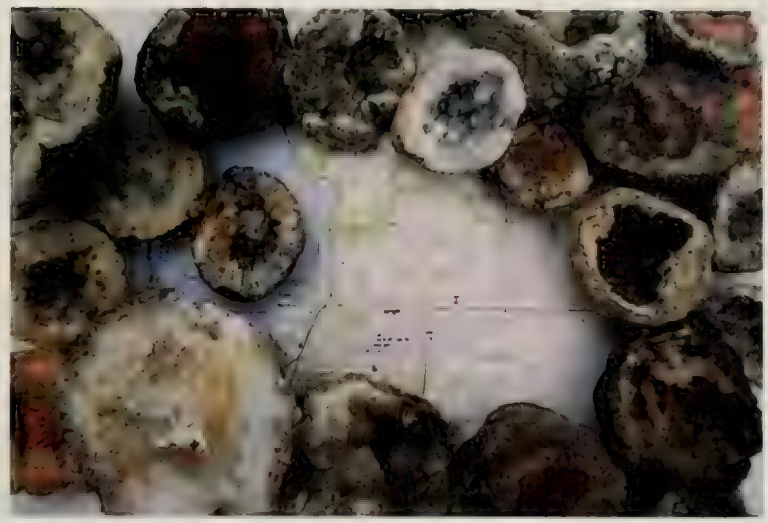
"You can tell they aren't just regular rocks by their shape and texture. They're round and have a distinct coating. They feel different than other rocks. It's something you learn with experience.



Rock collectors can find plenty of geodes around the creeks in Hancock County.

"Here, try this," she hands me a surprisingly light round rock. "A solid rock would weigh more than that. If the geode has a thin coating of crystals, it'll weigh less. If it has a thicker coat or is solid, it'll weight more."

"Sometimes I break them open. Most of the time, I find them broken open, but you hardly ever find the whole thing if it's already broken. Look inside," she says as she points to a broken geode. Inside there are thousands, maybe millions, of tiny, sparkling white crystals reflecting the sunlight. "We call this kind a 'snowball'. No two are alike."

A typical geode sawed in half will disclose a sequence of layers from outside in as follows: (1) a thin clay layer; (2) a layer of noncrystalline chalcedony, (3) crystals (usually quartz) projecting into the hollow interior

Looking around at her hundreds of geodes, varying in size, color, and shape, you would not doubt her. She has geodes lined with a smooth blue and grey quartz, called chalcedony. The blue chalcedony is valuable and used for jewelry. Some, like the snowballs, have tiny crystals; others have larger crystals in shades of purple, blue, and yellow.

"The minerals vary according to location," she explains. "Railroad Creek has more browns and yellows. Chaney Creek has more whites. I collect them because I like the way they look," she says, proudly pointing at her geodes. "I have all of these geodes, but I don't know the names of all the minerals."

Cracking Open the Mystery

Scott Beaty, a geologist at the Illinois State Geological Survey (ISGS) and a lifelong rock and mineral collector, is familiar with the minerals.

"Most states have geodes, except maybe Louisiana," says Beaty. "A small one is about two inches across, three to five is average, and this one is a monster," he says, pointing to a ten-inch geode that had been cut in half and carefully polished to reveal the clear quartz [illegible]

Beaty explains that there are several types of geodes. [illegible] found in Illinois) are formed when bubbles of gas push molten basalt (lava) aside and form a pocket—called a vesicle—that is later filled with mineralized water. These "geodes," technically called amygdules, may eventually form geodes—in a variety of shapes other than round—when the surrounding basalt erodes away.

"Limestone geodes, like the kind we have in Illinois," says Beaty, "don't form in the same way. There is disagreement on exactly how the cavities do form. They could be dissolved fossil cavities or possibly dissolution cavities in the limestone. In any case, mineral-rich water gets into the cavity and, as the water evaporates, a chalcedony (quartz) is formed around the wall of the cavity, creating a quartz shell. This "wall" is harder than the limestone around it. That's the reason why geodes are often so easily found. They 'weather out' because the surrounding limestone is much more easily eroded than the quartz shell of the geode."

After the shell forms, a thin clay coating can also form around the quartz as it reacts with the silica-rich water and surrounding limestone. Water may still be trapped inside the geode at this point, allowing the deposition of other minerals. More water may seep in over time, feeding more elements to the crystals still "growing" in the geode. Changes in temperature and pressure, as well as evaporation, cause precipitation, the deposition of mineral matter. Silica, the building block of quartz, will precipitate first.

"The little environment inside this hard shell is very good for mineral growth," says Beaty. "In the case of the famous geodes in Hancock County, if copper, iron, or other metals are in the trapped solution, minerals like pyrite, chalcopyrite, or tenorite will form. These are some of the unique minerals found in the limestone around the Keokuk/Hamilton area. Possibly, the shale surrounding the limestone has an abundance of these minerals. We don't know exactly why."

The Keokuk and Hancock County area is famous in geological circles for the variety and rarity of these minerals. "I knew about them when I was a kid in Texas and just starting to collect rocks," says Beaty. "About ten percent of the geodes you find there will be of real interest, maybe two percent will be of high mineral specimen quality."

"You can find geodes at Wildcat Springs Park, along Chaney Creek, at the lower level of the park," says Irene Schneider. "The Montibello access on the Mississippi River is also a good place to look. It is north of the bridge leading to Keokuk on highway 136, although you can't go down there all year. It is closed from December 1 to March 1 because of the eagles that nest in the area. You'll find geodes in all of the creeks around here."

"Tourists love them," she says. "'Rock hounds' come looking for good spots to find them. A man ran into the library once, shouting that he had found diamonds. Of course, he had found some sparkling quartz geodes." ■

Bob Wathen is a technical editor for the ISGS and a free-lance science and nature writer. He lives in Urbana.

Photos by Joel Dexter, ISGS Graphics and Publications Unit

Irene Schneider is well-known in Hancock County for her collection of geodes.

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Winter 1993 – The Prairie State

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Every time I visit the research facilities of the three Illinois Scientific Surveys and Hazardous Waste Research & Information Center (HWRIC) in Champaign, I am struck anew by the fact that, although their research and data collection are of the very highest order, these four agencies are no "ivory-tower" institutions.

Their work impacts us directly in a number of vital areas: the quantity and quality of our drinking water; the health of our streams, lakes, and rivers; the environmental impact of agricultural fertilizers and pesticides; the effects of insect pests on human health; the location and exploration of mineral resources; the monitoring of our state's air quality, flora, fauna, and natural areas; the amassing of geological data for the siting of major construction projects and landfills; and the management of solid and hazardous wastes.

The articles in this issue of ***The Nature of Illinois*** highlight not only the quality of their work but also their personal commitment to the people of the state. The study of prairies leads not only to habitat restoration but also to volunteer work and curriculum development for our schools. Global climate-change research leads to seminars for business, industry, and the scientific community as well as to educational outreach to schools. Their commitment is complete—as it should be—for, without the transfer of knowledge, how can we prepare ourselves and our children to understand and meet the challenges we face today and in the future?

So as you rediscover the wonders of Illinois through the pages of this magazine, take special note of the commitment and the professionalism of the Surveys and HWRIC. Take note, too, of the sound, scientific information that is available to policy-makers, business, and industry—and to you, as private citizens—because these four agencies are part of our Illinois heritage.

Cordially,

Edmund B. Thornton

Edmund B. Thornton
President, Board of Directors

***The Nature of Illinois* is published by The Nature of Illinois Foundation in support of the Illinois Scientific Surveys (Natural History, Water, and Geological) and the Hazardous Waste Research and Information Center. These four agencies span the state's natural resources and have a 150-year history of data collection, research, and service. Their activities encompass hundreds of vital research projects; educational outreach; and technical assistance to private citizens, government, business, and industry.**

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A golden garden spider spins a web among wispy milkweed seeds. Photo by Michael Jeffords

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Editorial Staff
Jean Gray *Editor*
Kathleen Kuiper *Assistant Editor*

Design
Mobium Corporation, Chicago

Stay In Touch
Name and address changes and membership information should be sent to The Nature of Illinois Foundation, 208 S. LaSalle, Suite1666, Chicago, IL 60604, (312) 201-0650. Master Card and Visa accepted.

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SURVEYING THE ILLINOIS PRAIRIE

by Susan L. Post and Michael R. Jeffords

Part One: A Vast Meadowland

The golden hues of late summer prairie grasses

> *Looking towards the setting sun, there lay, stretched out before my view, a vast expanse of level ground; unbroken, save by one thin line of trees, which scarcely amounted to a scratch upon the great blank . . . There it lay, a tranquil sea or lake without water. . .*
>
> Charles Dickens on a visit to Looking Glass Prairie, 1842

The first Europeans to see the Illinois country had crossed a vast ocean, snaked their way across a nearly impenetrable mountain range, and forged a path through a thousand miles of dense, primeval forest. They did it with indomitable spirit and by sheer force of will. Yet when they reached the edge of the eastern deciduous forest, approximated today by the Indiana-Illinois border, they stopped in wonder. Here was a landscape so different that their language had no word for it. Later travelers, trying to describe the area, turned to the sea for analogies, calling the area "a sea of grass" or "a vast ocean of meadow-land." In time this landscape came to be known as *prairie*, a word derived from the French word for meadow.

At first, the early settlers avoided living on the prairie because the treeless grasslands were thought to be infertile. In addition, prairies did not provide much-needed building materials, fuel, running water for livestock, or protection from the howling winter storms. The tough prairie sod presented an almost insurmountable problem to early agriculturists. The thickly interwoven roots of prairie grasses and forbs did not yield to the wooden plows developed for turning sod. Discovered only through trial and error, the most effective way to turn the prairie soil proved to be both an art and a science. With a massive breaking-plow, usually 6-12 feet long and pulled by several yokes of oxen, one-and-a-half to three acres could be broken in a sunup-to-sundown day. The sod had to be turned late enough in the season to prevent regrowth, but early enough to allow time for the vegetation to decay before autumn.

In 1836 John Deere invented the self-scouring, steel-bladed plow that allowed the virgin prairie soil to be broken on a large scale. The wild prairies became cropland at an astonishing rate—approximately 3.3% per year. In the early 1830s those who found the prairie habitable were considered part of the lunatic fringe, but by the end of the decade more than 300,000 people had settled on the prairie. During the 1850s and 1860s the establishment of railroads solved the problem of crop transportation to market, and the prairies were rapidly settled. By 1860 most of Illinois' prairie had disappeared.

Today prairies are confined to about 2,000 acres, less than .01% of their original extent. Unfortunately, it is easier to find examples of the prairie's *influence* in the "prairie" state—Prairie Street, Prairie State Games, Prairie Farms Dairy, Prairieview Estates, Prairie Rest Cemetery—than it is to find an actual prairie. Prairie remnants persist, however, along railroad lines, in pioneer cemeteries, even on the grounds of industrial complexes, growing in a forgotten corner of some storage yard yet to be developed.

A Flat Land

> *It is a matter of speculation to account for the formation of the prairies.*
>
> General Josiah Harmar, Illinois country, 1787

Because of the various subtleties of topography, soils, and moisture, at least 23 different kinds of prairies developed in Illinois. Add barrens, savannas, and glades, and the list increases to more than 30. These various prairies once occupied nearly 22 million acres of the state.

Of the 102 counties in Illinois, all but the southern nine counties contained large expanses of prairie.

During the past two million years Illinois has experienced several periods when glaciers brought loads of rock debris from the north and subjected old land surfaces to a relentless, grinding action According to Dwain Berggren of the State Geological Survey, "The consequence of

Wood lily

Big bluestem, symbol of the tallgrass prairie

this glaciation was that the terrain of Illinois, which resembled the rocky and hilly portions of present-day southern Missouri and Kentucky, was filled in with glacial mud, sand, and gravel. Think of the effects of the glaciers as an avalanche, rather than a bulldozer. The glaciers knead and grind the landscape. This smearing, plastering, pushing, and kneading produces a sandy, gravelly, pebbly mud with the odd boulder thrown in."

The final two advances of the ice sheets shaped the prairie region of Illinois. At its maximum the Illinoian glaciation covered nearly 90% of the state. The landscape left by the Illinoian glacier can be compared to that of a dry lake plain; it was flat. The later Wisconsinan glaciation deposited its drift (debris) over the northern quarter of the state. Here the glacier developed a succession of moraines, 50- to 100-feet high and 50- to-100 miles long.

Prairie shooting stars (Photo by Susan L. Post)

Berggren says, "The land is flat in places due to the moraines. Moraines confined water for long periods of time, and the lakebeds developed a flat bottom due to the settling of sand and mud. These lakes gradually eroded through the moraines and were eventually drained."

Betwixt and Between

The Season has been very hot and dry; there has scarcely been any rain since I have been here, but as the soil is very deep a drouth does not do the damage that it does in Maine.

Ebenezer Welch, Monmouth, Illinois, 1841

As the final glacier retreated, it left a moist land that was soon dominated by deciduous forests. Beginning about 11,000 years ago, most of the world entered a hot, dry period called the Hypsithermal Interval. Regularly occurring droughts parched the land, and massive, periodic fires raged across much of the American Midwest. As the land dried, the forests declined. Prairie began to replace the deciduous forests in southern Illinois and soon occupied much of the state during this period. Following the Hypsithermal, the climate became cooler and moister, but prairie had stabilized throughout much of the state. Although

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Blazing star and rose hips

Cardinal flower

Background illustration by Bobbie Lively-Diebold originally printed by the Kropp Company

Illinois has been a battleground of forest and prairie for the last 5,000 years (the climate appears to have been more favorable for the development of forests than for the maintenance of grassland), the prairie landscape persisted.

"Illinois is part of a grassland peninsula that sticks out from the Rockies," says Wayne Wendland of the State Water Survey. "It is an area that is covered by a Pacific air mass for six months or more and dry air for the rest of the period. Being on the leeward side of the Rockies, where there is less precipitation, also has aided in the development of grasses. It was too dry to support forest, too cold to support tropic vegetation, and too warm for boreal forests. Illinois was an area betwixt and between. Botanists proclaim that prairies ultimately developed and were sustained by fire, but these fires were a function of a climate that featured dry late summers, dry autumns, and frequent, large scale droughts."

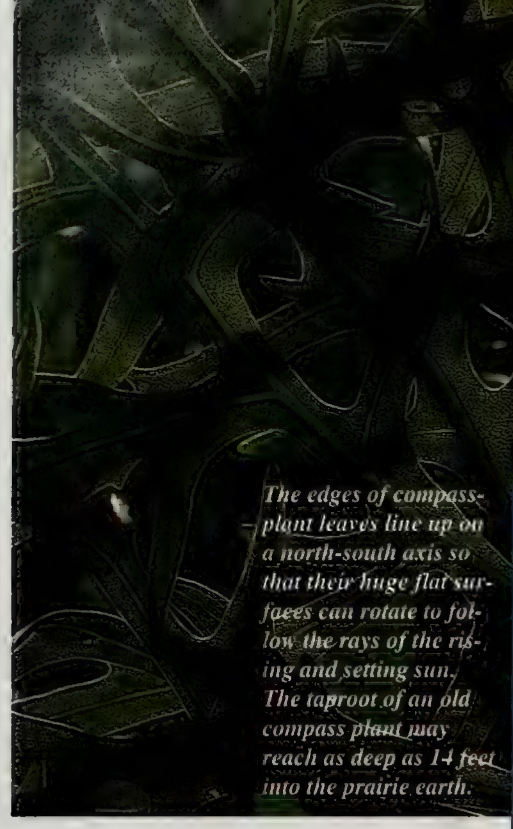
Ashes to Ashes

The last 12 miles we travelled after sundown and by fire light over the Prairie, it being on fire. This was the grandest scene I ever saw, the wind blew a gale all day, the grass was dry. . . we had in view at one time from one to 5 miles of fire in a streak, burning from 2 to 6 feet high. In high grass it sometimes burns 30 feet high.

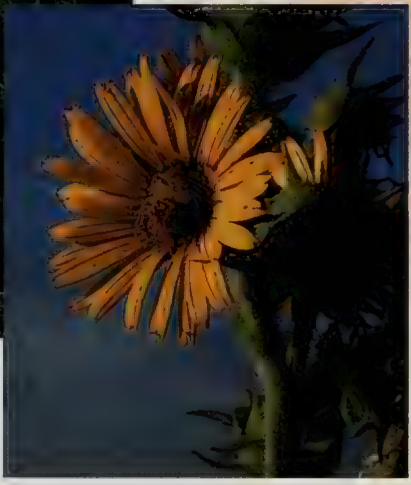
Alfred Brunson, Bureau County, 1835

Whether set by Native Americans or occurring from natural causes, the relatively flat ground, more than occasional drought, accumulation of dry litter, and high winds at certain seasons of the year all combined to foster fires. Prairie plants are better adapted to being burned than most woody plants, and the annual growth habit of the grasses and forbs helps protect them from fire. Each fall these species die back to underground organs (roots), leaving only dead material above ground. Prairie fires can move very quickly and become very hot above the ground and on the surface of the soil. Fortunately, though, soil is a good insulator so little heat penetrates to harm buried root stocks.

William McClain, Illinois Department of Conservation, has studied pioneer diaries and letters for the historic occurrence of fires. He was able to document 90 occurrences of fire on the Illinois prairies between 1679 and 1879; over 90% occurred during the fall. His conclusions



The edges of compass-plant leaves line up on a north-south axis so that their huge flat surfaces can rotate to follow the rays of the rising and setting sun. The taproot of an old compass plant may reach as deep as 14 feet into the prairie earth.



are that Native Americans used fire in their annual hunts, usually a ring fire. These annual hunts took place during Indian summer, a period of mild dry weather that usually occurs at the end of October and into early November. During times of drought, the fires often "got out of hand" and were more extensive.

"To reduce the hazards of prairie wildfires in the fall, European settlers began to use prescribed burns during the spring and summer," says McClain. "The spring burning of the prairie appears to be an introduction of European man. As early as 1807, laws were on the books against setting the prairie on fire and carried fines of $5 to $100; these laws were not enforced. Not until Smokey the Bear's appearance did fire suppression begin."

Dust to Dust

The soil of this district embraces almost every description, from poor sand to rich clay of strong texture. It is of all colours, and generally of superior quality . . . The black sand, of which the prairies are partly composed, seems of a penetrating nature and adheres to the skin like soot.

Patrick Shirreff, Sangamon County, 1833

Prairie soils are deep, mostly well-aerated, rich, and moist. In a prairie community, about two-thirds of the plant mass is beneath the surface of the soil in the form of rhizomes, bulbs, corms, and other plant parts. The roots of big bluestem may reach a depth of five to seven feet, while those of the compass plant can extend to depths of nine to 14 feet. When these below-ground portions die, they decay in place to greatly enrich the soil with organic matter. The rich and productive soils of most of the Midwest cornbelt had their genesis under prairies. Once the European settlers learned of the fertility of the prairie soil, had a plow that could effectively turn the sod, and found a way to transport their crops to distant markets, the prairies of Illinois were doomed to quickly disappear.

The dark brown or even black prairie soils, reflecting their high organic content, developed in a relatively short period of time, about 14,000 years, after the last glacier melted away. The parent material for the rich soil in most of Illinois was windblown silt deposited during periods of glacial retreat. When the glaciers melted during the warm seasons, tremendous floods of meltwater poured down major river valleys and deposited massive amounts of sediment on floodplains. During the dry, arctic-like winters these sediments dried out. "Strong winds blowing across the bottomlands blew the dust out of the valleys. This wind-blown dust, known as loess, accumulated in deposits of varying thicknesses," says Berggren. "Some areas have as much as 50 feet of loess on the surface."

An Ocean of Grasses and Flowers

In May and June the prairie was an ocean of flowers of every possible hue, glittering and blazing in the sunlight.

Henry Blevins, Macoupin County,
around 1830

To early settlers the grasses formed a seemingly impenetrable barrier—an ever-shifting panorama of big bluestem, Indian grass, cord grass, and others—that sometimes reached heights of ten feet or more. Although grasses formed the bulk of the prairie vegetation (90% of the foliage), they usually constituted less than 20% of the species. Multi-hued wildflowers provided a welcome relief to the infinite shades of green. More than 200 different species of plants, belonging to 45 different families, are known from Illinois prairies. Most of these species grow on the relatively flat or slightly rolling moist prairies, in soils with good drainage. Although each species of prairie plant tends to grow in a particular type of prairie, very few are restricted to prairies, and nearly all prairie species occur in habitats other than prairies and in areas other than the prairie region.

Not all prairie plants are noticeable at any given time; rather, there is a progression of species through the growing season. Only a few species—low herbs such as prairie violet and blue-eyed grass—flower very early in the spring. In late spring to early summer, a rainbow of colors appears—shooting stars, wild hyacinth, bird's foot violet, downy phlox, and hoary puccoon. These, too, are relatively short plants, seldom exceeding one-to-two feet in height. During the summer a large part of the prairie is in flower, each succeeding forb increasing in height as the summer progresses to keep pace with the lengthening grasses. By midsummer, the rich beauty of the prairie fully surfaces; the tall grasses bloom and the colors of the forbs diversify with dozens of species blooming in a single day. By late summer and early fall, the yellows and browns are in control with legions of goldenrod and sunflowers. Yet flashes of the brilliant pink and vermillion of blazing stars, false dragonhead, and New England aster break the amber dominance. The last plants to flower are the gentians and ladies' tresses orchids, which mimick the habit of diminutive early spring species, growing in the shadow of the towering grasses.

An Ark Full of Birds and Mammals

Many other kinds of animals are found in these vast plains . . . stags, deer, beaver, and otter are common there, geese, swans, turtles, poules d'inde, parrots, partridges, and many other birds swarm there, the fishery is very abundant, and the fertility of the soil is extraordinary.

Louis Hennepin, Kankakee Valley, 1679

Even though native Illinois prairies have been essentially gone since the turn of the century, most of the prairie animals have been able to survive because of their ability to adapt and utilize hayfields, pasturelands, and roadside meadows. The only prairie mammal known to be extirpated from Illinois is the bison. Bison were the largest mammals on the prairie, and an acre of tallgrass prairie could support one bison for two months. Other species of prairie mammals have suffered less. Although prairie conditions have been drastically altered, certain species like the plains pocket gopher, meadow vole, and western harvest mouse have actually extended their ranges. Others, such as the coyote, 13-lined ground squirrel, and eastern cottontail have increased in abundance.

A number of prairie bird species, with the exception of the sharp-tailed grouse, which was soon extirpated, initially benefitted from the conversion of prairie to farmland. Those that benefitted most include the horned lark, vesper sparrow, and the greater prairie chicken. By the 1860s the prairie chicken had its highest population in the state (ten million birds). The timberlands had been cleared, and portions of the prairie sod had been broken and planted in grain. This interspersion of cropland and unbroken prairie provided ideal conditions for the prairie chicken. Soon after reaching their peak, though, the birds began to decline with the demise of the remaining prairie. Currently, fewer than 50 bird species survive in the state. Along with the greater prairie chicken, populations of several other birds declined with the destruction of the prairies. Today the loggerhead shrike, Henslow's sparrow, Swainson's hawk, and short-eared owl are all listed on the Illinois Threatened and Endangered Species list.

Bottle gentian

Remnants

What a pity that some of it could not have been preserved, so that those born later might enjoy its beauty also.

Dr. A. W. Herre, 1890

The prairie, formed by the interaction of geology, climate, and fire, supported a diversity of life forms. In today's world, prairies survive in infinitesimally small parcels. A goodly number, more than 75, are protected as Illinois Nature Preserves. To experience an Illinois prairie requires diligence, knowledge, and a good map. Prairies do persist and can provide a glimpse into the state's biological past; they can be found mainly in isolated pioneer cemeteries and along railroad rights-of-way. It is difficult, though, for individuals today to grasp or even imagine the significance of a landscape that currently occupies only .01% of our state. ■

A Directory of Illinois Nature Preserves, *published by the Illinois Department of Conservation, is an excellent resource for locating prairies as well as other natural areas in the state. Currently out-of-print, it can be found in public libraries and universities throughout Illinois.*

Part Two: Serious About Prairies

All morning, as they worked, the area was silent. The only noise was the rustling of grass in the ever-present wind and the occasional shouted instructions passed between the diligent workers erecting a sign—Bonnie's Prairie: A Sand Pond and Sand Prairie Dedicated to Bonnie Peters. At 2:00 PM whistles roared as another parcel of Illinois prairie was preserved. It didn't matter that the celebratory noise was from a passing train; the 85 participants, representing friends of the prairie and friends of the late Bonnie Peters (on whose land the prairie stands), were pleased. Young and old enjoyed the day and, with the help of an Illinois Natural History Survey (INHS) botanist, tours were conducted, plants were identified, and a mild controversy regarding the scientific name of horsemint was resolved.

A SAND POND & SAND PRAIRIE
DEDICATED TO BONNIE PETERS

Erecting the sign for Bonnie's Prairie

By the time the Illinois State Laboratory of Natural History (now the Illinois Natural History Survey) was established in 1877, the large expanses of prairie were nearly gone. Despite the decline of prairie habitat, three studies were published in the early 1900s, *The Illinois Sand Prairies, Ecological Surveys of Prairie Vegetation*, and *The Automobile and Prairie Wildlife*. During the late 50s and early 60s two publications significant to prairies appeared—*The Hill Prairies of Illinois* and *A Comparative Study of Bird Populations in Illinois*. In the latter, two Survey ornithologists, Richard and Jean Graber, repeated bird censuses from the turn of the century and documented population changes for several species. Recently, during the 20th anniversary of Earth Day in 1990, the Survey hosted a symposium entitled *Our Living Heritage: The Biological Resources of Illinois*. Various experts from across Illinois presented their views and data on the present status of forests, wetlands, streams and caves, and, of course, prairies. Thus, even though—*or, perhaps, because*—almost no prairie is left in the state, the INHS continues its efforts in the areas of research, education, reconstruction, surveillance, and preservation.

A Blur of Color—Corridors for Tomorrow

Illinois' interstate highway system is the third largest in the nation, with about 1,900 miles of corridors, 370 interchanges, and 31 open or proposed rest areas. One hundred and thirty-five thousand acres of land are associated with this system. For two years Kenneth Robertson, an INHS botanist, has headed a team of specialists working on a project called Corridors for Tomorrow. "We rank 49th among the states in original prairie, forest, savannah, and wetlands that have survived; only Iowa is lower." says Robertson. "This loss of habitat has been responsible not only for the extinction of some species, but also for a drastic reduction in the abundance of most native species." The initial focus of the Corridors for Tomorrow project will be to use native species to revegetate the interstate highway system. The interstates are areas of highest priority because they are the most heavily used state roads and their corridors are in state ownership and thus subject to less pressure from economic and ownership changes than most land in the state. The project proposes revegetating with native Illinois plants. Although Robertson is the first to admit that a complete restoration cannot be achieved, each unit of the interstate highway system—corridors, interchanges, and rest areas—will provide opportunities for the effective use of native plant communities. Along the corridors, instead of 120 species mixed together, the prairie ecosystem will be dissected. Its components, presented in mass plantings of showy species at intervals along the corridors, will be much easier to see and appreciate at 65 miles per hour! Interchanges, due to the their relative isolation and large size, will allow for a more comprehensive prairie development. At rest areas, educational interpretations are planned along with more complete prairie reconstructions.

Wild lupines

How to Start a Prairie Patch

Incorporating native prairie plants into the landscape can be as simple or as elaborate a project as one cares to make it. In essence, all that is needed is a sunny location, a plot of tilled ground—preferably with sod removed, or in an area that is relatively weed-free—prairie seeds or prairie seedlings, and loving care. Future activities may include hand-weeding, watering during periods of low rainfall until the plants become established, and regular burning (if the plot is large enough). Aim for a pleasing mix of grasses and forbs. Remember, only 20% of the species are grasses, but these make up about 90% of the foliage in a native prairie. Thus, if you want to achieve "the look of a native prairie" you may want to take these percentages into consideration.

The National Wildflower Research Center is an excellent source for information on landscaping with native plants. For a complete introductory packet write to them at 2600 FM 973 North, Austin, Texas 78725. There is a $2 charge for nonmembers.

By providing the potential for more than 130,000 acres of right-of-way for native vegetation, the corridor project could insure a future for many of our native organisms. The prairie corridors will provide habitat to native grassland birds, wintering ground for upland gamebirds, and a food source, not only for migrating birds, but also for insects and small mammals. Revegetation will increase the average size of our habitat fragments, decrease habitat isolation by providing connecting corridors, and contribute to the scenic beauty of Illinois.

The Prairie Chicken

The prairie chicken has been a subject of Survey research efforts since its founder, Stephen A. Forbes, began studying it in 1912. Substitute prairies of hay, pasture, or grass seed meadows provided some habitat for prairie chickens displaced when prairie habitat was destroyed during the last century. But when the acreage of substitute prairie also declined, so, inevitably, did the prairie chicken. Like the bison and the sharp-tailed grouse, prairie chickens appeared to be on the verge of extirpation from Illinois.

During the 1960s the INHS, along with the Prairie Chicken Foundation of Illinois, the Prairie Grouse Committee of The Nature Conservancy, the Illinois Department of Conservation, the Nature Preserves Commission, and interested individuals (including Gaylord Donnelley, founder of The Nature of Illinois Foundation) began to acquire land for sanctuaries. Annual counts of prairie chickens on their booming (mating) grounds were also started. "The prairie chicken would be long gone from the state if not for the two sanctuaries," says Glen Sanderson, retired Survey wildlife biologist. Both Illinois prairie chicken sanctuaries are now dedicated Nature Preserves.

Survey Prairie Restoration

During an Economic Entomology staff meeting in December 1982, William Luckmann, the Center's director, mentioned the call for proposals for the use of agricultural land on the University of Illinois South Farms. John Bouseman, a Survey entomologist, remembers quickly

Author-photographer biologist [illegible] with camera equipment in a field of blazing stars

Prairie burns at South Farm in Champaign often bring out a worried fire department.

drafting a proposal requesting land on which to establish a plot of native prairie vegetation. Once it was established, Bouseman pointed out, Survey scientists would use the plot for investigations of native plants and their insect associates. He thought a South Farm location would be ideal because of its proximity to the Survey. "Luckmann told me that this proposal was a great idea," says Bouseman, "although he doubted that the UI College of Agriculture would think so." Nonetheless, in March, Dr. Luckmann received a letter from the Assistant to the Director of the Agriculture Experiment Station approving the plan and in June, 1984 a 1.5 acre plot was planted with prairie grasses and forbs. Bouseman feared the project might be doomed when it didn't rain for six weeks after planting, yet the seeds did germinate, and soon a respectable plot of prairie vegetation began to develop.

Following several yearly burns (that have brought out a worried fire department on occasion) and supplemental plantings, the Survey prairie is established and today is a valuable educational tool. Early each school year, area teachers contact Michael Jeffords, INHS Public Relations and Education Officer, to arrange field trips for their third grade classes—the culmination of a Champaign school prairie unit, based on curriculum developed in cooperation with Survey staff. The visit, led by volunteer Survey scientists, is hands-on as students take soil cores and identify plants. Touching, smelling, feeling, and even tasting are encouraged, and if the groups are lucky—and quiet—a ground hog, fox, gold finch, or even a deer may appear! Each student gets a chance to use an insect sweep net and collect a few stems of big bluestem or Indian grass so the experience can be shared at home. For most, this is their first experience in a prairie. Cashundra, a third grader from Champaign, wrote, "I really enjoyed the field trip. Thank you for letting us run through the grass and letting us take some with us. That was my first time ever being on the prairie and I learned a lot."

After Hours

Survey botanist John Taft says that studying prairies is just part of the job (he does botanical surveys where highway projects threaten natural sites, searches for threatened and endangered plants, and evaluates natural quality vegetation) and that you won't find him in a prairie on the weekend. Nothing could be further from the truth. Taft helped erect the Bonnie's Prairie sign and led field trips on a Sunday, and he is steward of Prospect Cemetery Prairie. Being steward involves weekend brush cuttings, burning, and other management activities.

Survey employees are also involved in various organizations, including the Illinois Native Plant Society and Grand Prairie Friends (GPF), a prairie preservation based in Champaign County. Survey scientists serve on the governing board of GPF (Joyce Hofmann, a mammalogist, is president this year), are on the scientific advisory board, and regularly participate in workdays. Marilyn Morris is leading an effort with the Champaign County Forest Preserve District to restore a savanna along the Middle Fork of the Vermilion River. Scott Simon is a leader in The Nature Conservancy's Volunteer Stewardship Network. Morris and Simon are both wetlands biologists with the Natural History Survey.

For the Future

Whether working on revegetating highway corridors, saving the last of the state's prairie chickens, restoring remnant pieces of habitat, or taking time to lead prairie field trips, Survey employees are intimately involved with our prairie heritage. Stephen A. Forbes thought it was important that "the children must be drawn towards and not away from the woods and fields and waters and must be led to see more clearly." A letter from David (a third grader) sums it up best: "I like the big bluestem. Thank you for letting us run through the grass and letting us catch grasshoppers and have some of the past." Forbes would be pleased. ■

Susan L. Post is an assistant research biologist at the Natural History Survey in the Center for Economic Entomology and Michael Jeffords is an associate scientist in the Center for Economic Entomology and the Survey's liaison for public relations and education. Their front yard prairie patch is in its third year and flourishing.

All Photos by Michael Jeffords except where indicated

SURVEYING ILLINOIS

BIORHYTHMS

Illinois Natural History Survey (INHS)

Insect Info and Help for Growers

Six University of Illinois extension entomologists, who are also members of the Natural History Survey, provide up-to-date information on the management of insect pests of field and forest and on the control of mosquitoes in urban settings. In addition they offer guidance designed to decrease pesticide contamination of surface and groundwater and reduce environmental and health hazards associated with the use of insecticides. Three newsletters, *The Home, Yard, & Garden Pest Newsletter*, *The Pest Management & Crop Development Bulletin*, and *The Illinois Spray Report* are mailed to more than 4,000 Illinoisans and reach many additional thousands.

More than 100 educational programs, led each year by extension entomologists, include pesticide applicator and seed clinics; master gardener and greenhouse courses; fruit, vegetable, and Christmas tree grower conferences; science teacher workshops; and native plant and environmental health conferences. Five additional educational conferences, attended each year by more than 1,500 Illinois citizens, are devoted to topics as diverse as pest identification and environmental issues. The proceedings of two of them—the Crop Protection Workshop and the Agricultural Pesticides Conference—are published annually and are highly regarded by members of the agricultural community. For further information on these publications and programs, contact the Entomology Extension Office, (217) 333-6652.

Prairie Fires and Prairie Insects

Most prairie burns are designed to manage for plant diversity. Unfortunately, not much is known about the effects of burning on prairie animals, insects in particular. In fact, the potential vulnerability of prairie insects is increasingly being used as an argument to reduce or eliminate fire from native grasslands. A new Survey project will experiment with different fire management strategies (burning at different seasons and with varied frequency) to help resolve the issue of how fire management affects native prairie insects. The study will target different insect groups, such as certain rare moths and prairie-inhabiting leafhoppers, that are thought to be particularly vulnerable to fire.

Land Cover Mapping

Land cover information describing the vegetation and man-made features of the landscape is vital baseline data for many kinds of environmental research. It is also information that is costly to produce using traditional techniques and tends to become quickly outdated. The most recent comprehensive land cover mapping of Illinois, completed by the US Geological Survey from aerial photographs in the mid to late 1970s, is now in need of update and expansion.

A project is now under way at the Natural History Survey to map Illinois land cover using Landsat Thematic Mapper (TM) satellite imagery. Cloud-free data (collected in the spring and early summer, from May 26, 1988, to June 4, 1991) have been purchased to cover the entire state. The satellite imagery is being converted to usable land cover information using the sophisticated computer technology of the Illinois Geographic Information System.

The US Environmental Protection Agency is assisting the Survey with development of the satellite data and will use the completed land cover information for their environmental assessment programs. Land cover classes that will be mapped include high- and low-density urban areas; cropland; grassland; deciduous, evergreen, and mixed forest and shrub areas; exposed land; and several classes of wetlands and open water. Mapping resolution will be approximately 0.5 hectares, many times more powerful than was previously available.

CURRENTS
Illinois State Water Survey (ISWS)

New Scholarship Fund Established

The family of the late William C. Ackermann announces the establishment of an honorary stipend for undergraduate students who plan to focus on water resource issues in the department of Civil Engineering at the University of Illinois at Urbana-Champaign. The scholarship replaces the William C. Ackermann Distinguished Lecture Series in Water Resources which was established in 1990 to honor and extend the scholarship and contributions of William C. Ackermann. Ackermann was Chief of the Illinois State Water Survey and Professor of Civil Engineering at the University of Illinois from 1956 to 1979. The fund will be administered jointly by The Nature of Illinois Foundation and the Water Survey. For further information or to make donations to the Ackermann Endowment, contact The Nature of Illinois Foundation, 208 S. La Salle Street, Chicago, IL 60604; (312) 201-0650.

Just because it's called the "Water" Survey don't overlook the fact that weather and climate—the atmospheric sciences—are a vital part of the ISWS mandate.

Understanding the Issues "By Degrees"

The Global Climate Change Program has published a series of fact sheets entitled "By Degrees." These one-pagers clarify such topics as "What is the Greenhouse Effect?", "What Are the Greenhouse Gases?", "What Can We Do About Global Warming?", and "Past Climates of Illinois." "By Degrees" is currently used in Washington D.C. to educate legislators about global climate change issues. It is used closer to home as well, in schools and by the general public, helping to demystify this "hot" topic. For those desiring a slightly more comprehensive explanation of the climate change issue in one document, the Program has developed "Global Climate Change and Illinois." Publications are available free-of-charge from the Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820.

Climate Change Literacy for Kids

Stephen Vermette, Assistant Director of the Global Climate Change Program, leads workshops for teachers interested in developing a global climate change curriculum. He also visits classrooms, as his schedule allows, and has a story to illustrate every concept and demonstrations to help youngsters grasp complicated ideas. "The kids ask thought-provoking questions," he said. "One day when I finished explaining to a group of fourth graders that trees help us by absorbing CO_2, one girl asked me if the CO_2 leaked out if there were holes in the trees. That's a different kind of question than I usually field at professional seminars. It shows these youngsters are taking nothing for granted."

For information on teacher and student workshops, call Vermette at (217) 333-7128.

Porter J. Womeldorff, Illinois Power Company Vice-President: "The greatest challenge is to look beyond the near-term impacts and costs and to plan for the future."

How's the Climate for Business and Industry?

More than 75 public officials; representatives from business, industry, agriculture, and forestry; and the media attended an all-day conference last October entitled Global Climate Change: Focus on Illinois, An Economic and Business Perspective. The conference, sponsored by the Illinois State Water Survey and Illinois Power Company, focused specifically on Illinois, recognizing that the effects of global climate change as well as adaptation and mitigation responses will be felt and implemented at the local level.

Speakers addressed Illinois climate trends, potential effects on the state's natural resources, and probable impacts on business and agricultural interests. The conference represents an opportunity for researchers, business, and policymakers to better understand and address climate change issues as they affect Illinois, and, in turn, to understand how Illinois—a source of greenhouse gases—may affect the climate of the world.

GEOGRAMS

Illinois State Geological Survey (ISGS)

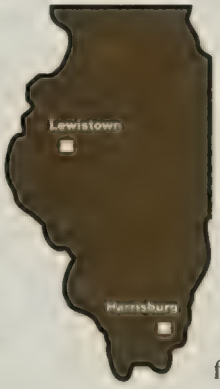
ISGS Helps Engineers Ride Out the Great Chicago Flood

The Geological Survey played a key role in helping to bail out Chicago last April after the Chicago River burst through a weakened tunnel wall beneath the Merchandise Mart, pouring more than 250 million gallons of water, silt, fish, and debris into underground freight tunnels and basements at the Board of Trade, Merchandise Mart, Tribune Tower, and nearly 200 other downtown buildings.

Charged with helping with the clean-up, Harza Engineering contacted the ISGS for geologic and hydrologic information in order to devise a sound dewatering plan. Harza's goal was to pump out the water as rapidly as possible without triggering a further catastrophe by causing the walls of the tunnels and basements to collapse from a too-rapid release of water pressure. Armed with information rushed from the ISGS archives in Champaign on the geologic materials underlying the Chicago area, and with the consultation of ISGS geologists, Harza Engineering was reassured that the predominantly clay materials would permit them to proceed with their plan to dewater the tunnels as rapidly as possible.

Take a Geological Field Trip!

Old Stone Face overlooks the lower topography surrounding Harrisburg. The large flat areas near the town were once the bottom of an extensive, but short-lived, glacial meltwater lake.



The first geological field trip of spring will be Saturday, April 17 in the Harrisburg area of Saline County in southeastern Illinois. The trip will cover gently rolling bedrock hills, thinly mantled by glacial deposits, as well as the more rugged, unglaciated section known as the "Illinois Ozarks." Underlying much of the field trip route is Pennsylvanian-age bedrock that was deposited nearly 310 million years ago and is now an important source of coal. Older rocks of Mississippian age (some 330 million years old), underlying the Pennsylvanian strata in the northern half of the county, produce oil. Fossils can be collected from some Mississippian rocks where they are exposed along the Shawneetown Fault Zone.

The Lewistown-Spoon River area, site of the May 22 trip, is located in central western Illinois in the Galesburg Plain, formed by glaciers about 200,000 years ago.

Blanketing the surface is eight to 25 feet of windblown silt (loess) of Illinoian and younger Wisconsinan age (approximately 150,000 to 12,000 years old). Spoon River, immortalized in both Indian lore and modern literature, has eroded down through the glacial deposits and exposed Pennsylvanian and Mississippian bedrock in its valley walls. At several places along the top of the steep valley walls, the view of the picturesque river valley below is breathtaking. Rocks, minerals, and fossils can be collected from glacial gravels. Fossils are abundant in some bedrock strata.

Open to all, these free expeditions provide frequent stops for exploration, discussion, and rock and fossil collection. The field trips are especially helpful to teachers planning earth science, geography, and history units.

For additional information on times, suggested clothing, and meeting places, write the ISGS, 615 E. Peabody, Champaign, IL 61820, or call (217) 333-4747. The hearing impaired should call TDD (217) 785-0211.

Energy Exhibit Continues at Chicago Museum

"Energy: Choosing Our Future" runs through April 25, 1993, at the Chicago Academy of Sciences, 2001 North Clark Street, Chicago. This exhibit looks at coal, oil, and natural gas as well as alternative fuels such as nuclear energy, solar energy, and wind power. A resource section is loaded with energy-saving suggestions, and an interactive computer system challenges visitors to make individual choices about their use of energy. At the end of the exhibit, a computer terminal shows them how their choices would affect their family budget and the local, national, and global environment and economies. A major goal of the exhibit is to help people make informed personal choices about their own energy use. The Geological and Water Surveys served as consultants to the exhibit designers. (See "The Future of Our Energy Resources," The Nature of Illinois, Spring/Summer 1992.)

CENTERING ON WASTE

Hazardous Waste Research and Information Center (HWRIC)

Pollution Prevention Awards

In December, eight Illinois businesses, industries, and trade and community organizations received top awards for their hazardous and solid waste reduction programs in the sixth annual Governor's Pollution Prevention Awards competition. An additional 16 companies and groups were awarded certificates of merit.

Two facilities singled out for their broad-based pollution programs were **Navistar International Transportation Corporation** (Melrose Park) and **Chrysler Corporation** (Belvidere).

Examples of other award-winning innovative programs are as follows:

The Chicagoland Processing Corporation (Mt. Prospect) developed and patented a system to reclaim silver from film. Contrary to standard industry practice, no cyanide is used in their improved recovery process. The silver recovered is used to mint commemorative sports coins (they are licensed by the NBA, NHL, NCAA, and Major League Baseball) and the remaining film components are shipped to Eastman Kodak for reuse in new film.

Justrite Manufacturing (Mattoon) achieved 100% reduction in paint-associated waste and VOC (volatile organic compounds) emissions by replacing their solvent-based spray paint line with a solvent-free powder-coated product. This new product eliminates toxic emission to the air and allows oversprays to be recovered for re-use. Not only has Justrite achieved a higher quality paint finish, but worker safety is much improved.

The waste prevention team at **Hevi-Duty Electric** (Mt. Vernon) reduced the amount of PCB-contaminated debris from the remanufacture and decommissioning of electrical distribution equipment. They also established a waste-tracking system for measuring the actual waste reduction achieved during varied processing times and under different conditions. In 1991 a $3,200 investment reduced plant waste by one-half.

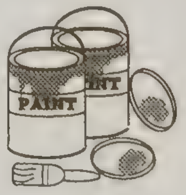
The Interlakes Companies, Inc. (Pontiac) reduced plant disposal costs by $189,000 (79%) by working with their paint supplier to eliminate heavy metal (lead and chrome) from their paint, while maintaining their high-quality finish. Improved housekeeping practices, the replacement of chlorinated solvents with non-hazardous cleaners, and employee training programs resulted in a high degree of cooperation and increased worker safety.

The Chemical Industry Council of Illinois promotes pollution prevention through its 117-member trade association by conducting educational programs for industry, students, and teachers; by actively supporting USEPA's 33/50 Program and IEPA's Partners in Prevention Program; and by promoting their own Responsible Care programs.

Applications for the awards were reviewed by HWRIC, a division of the Illinois Department of Energy and Natural Resources. The Illinois Environmental Protection Agency does a compliance review and the finalists are then approved by the Office of the Governor. HWRIC, a non-regulatory agency, works closely with Illinois industries, small businesses and manufacturers, and community groups to help them implement pollution prevention programs and solve waste problems.

Lieutenant Governor Bob Kustra presents the Governor's Pollution Prevention Award to Richard Zielinski and Dan Wenstrup of the Chemical Industry Council of Illinois. (HWRIC photo by Laurie Case)

Paint Disposal Study Presented



HWRIC's Research Program Manager Jacqueline Peden described current disposal practices of Illinois paint manufacturers and users at a Hazardous Waste Conference for Southern States last fall. The conference was held in Biloxi, Mississippi. The information presented was based on a comprehensive study prepared by the Research Triangle Institute, Research Associates and HWRIC to meet the mandate of the Governor and the Illinois General Assembly. The Executive Summary of *Paint Waste Reduction and Disposal Options* is available through HWRIC, One East Hazelwood Drive, Champaign, IL 61820.

HWRIC Director Elected to Head Advisory Board

Last fall HWRIC's Director David L. Thomas was elected Chairman of the Advisory Board of the National Roundtable of State Pollution Prevention Programs. Thomas has been a member of the Roundtable advisory board since it was first established in 1990.

The Roundtable is a national forum the purpose of which is to promote the development, implementation, and evaluation of efforts to avoid, eliminate, or reduce waste generation. It is the only organization devoted strictly to this topic. The Roundtable Board was expanded in 1992 and now has representation from each of the ten EPA Regions and at least 44 states. Consultants and industry representatives can join the Board as non-voting members.

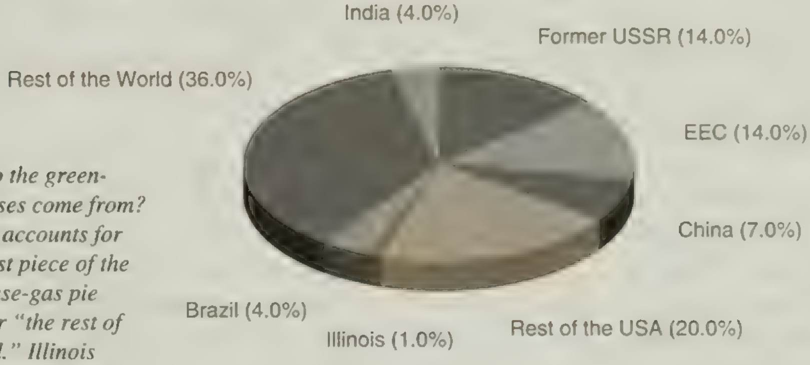
GLOBAL CLIMATE CHANGE

Can We Get Ready for It?

by Carolyn Arden Bresler

It's the year 2050, and the weather in Illinois isn't what it used to be. The wind blows harder and it doesn't rain as much—bad news for Illinois farmers, who are harvesting less corn and sorghum. The average temperature is 90°F or hotter on two out of three summer days. In Chicago, the ozone levels are higher and more people are suffering from heat-related illnesses. The beaches along Lake Michigan are huge, and some of the harbors have turned into dry docks. No wonder: the water level in the lake is nine feet lower than it was in 1990.

Regional Contributions to the Enhanced Greenhouse Warming



Where do the greenhouse gases come from? The USA accounts for the largest piece of the greenhouse-gas pie except for "the rest of the world." Illinois contributes about 1% of the world total.

This forecast of the future is one of several possible outcomes—and probably the most extreme—according to scientists in the Illinois State Water Survey's Global Climate Change program. The program's director, Stanley Changnon, and his colleagues are studying what might happen to the level and supplies of water in Illinois and the Great Lakes if global warming occurs. Global measurements indicate that atmospheric concentrations of carbon dioxide (CO_2) will double by the middle of the next century. That could cause the average global temperature to rise as much as 9°F. If this happens, the climate of Illinois could become more like that of Texas and Oklahoma: hot and dry. Such a drastic change would wreak havoc on our water resources by increasing evaporation, reducing stream flow, and drying up water supplies.

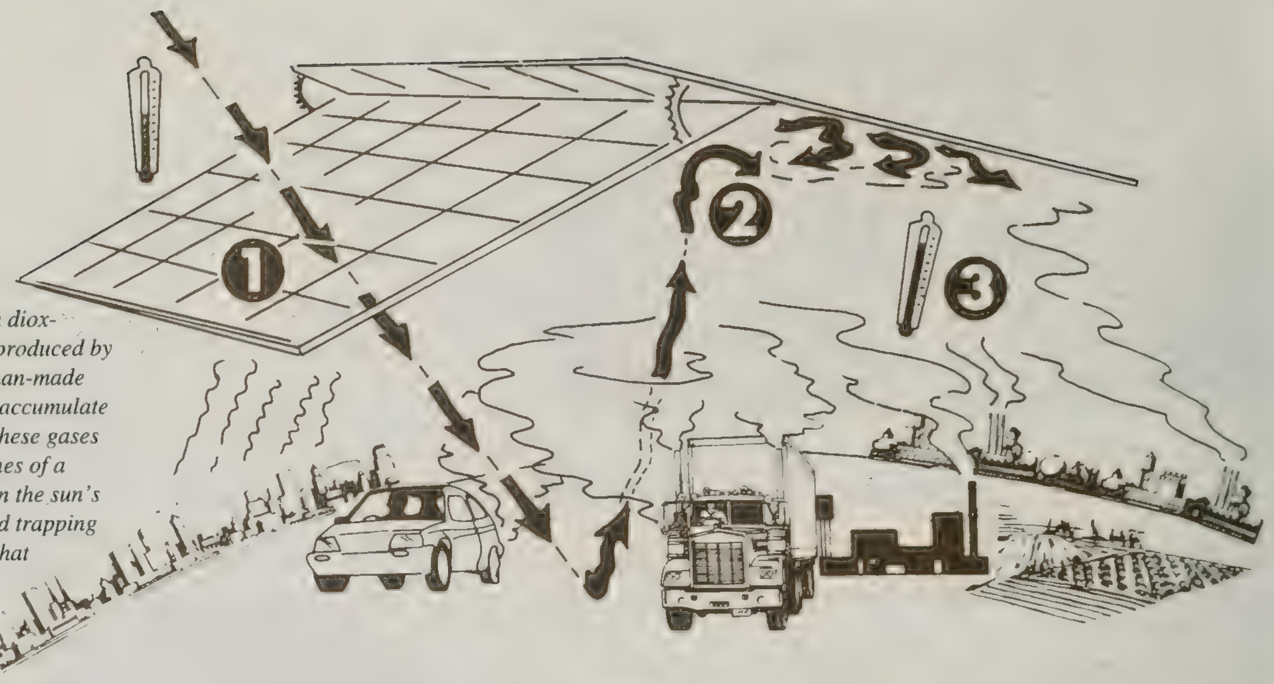
Stanley Changnon

As Changnon says, "Global climate change represents the single greatest environmental threat that humans have created."

Why should the citizens of Illinois be concerned about global climate change? For two reasons: Because our agricultural and natural resources may be significantly altered by a change in the climate, and because laws designed to control global warming—such as limiting the release of greenhouse gases into the atmosphere—may greatly affect the Illinois economy, local industries, and the daily lives of those who live and work here.

In 1991 the Illinois General Assembly designated the Water Survey as the state's center for scientific research and information related to global climate change. Under its mandate "to monitor and study the atmospheric and water resources of Illinois," the Water Survey has collected more than 100 years of weather records. Its database is among the best-documented in the world—which makes the Water Survey an ideal place for climate change research. The purpose of the Global Climate Change program is threefold: to *study* climate change and its potential effects (natural, social, and economic); to *monitor* climate-related environmental changes; and to *disseminate information* about global climate change and its research to the public, scientists, planners, and government officials.

"The problem with the word 'global' is that most people don't think it's something they have to worry about here at home," says Stephen Vermette, Assistant Director of the Global Climate Change program. "But the fact is, you can't escape it. 'Global' includes Illinois



We live in a Greenhouse. Carbon dioxide and other gases produced by industry and other man-made and natural sources accumulate in the atmosphere. These gases act like the glass panes of a greenhouse, letting in the sun's warming rays (1) and trapping the infrared energy that is radiated from the warming (2). As a result the air is heated (3).

and if the citizens of Illinois are going to make wise decisions about the climate change issue, then they must have high-quality scientific and technical information about the subject."

Tracking the Climate

Monitoring the daily weather and climate conditions is important to the Water Survey's work. "We continually track conditions—such as temperature and precipitation—to detect deviations from a baseline and see how change is developing now so that intelligent remedies can be invoked as necessary," says Illinois State Climatologist Wayne Wendland.

To date, historical data shows that Illinois has previously experienced shifts in its average annual temperature. From about 1887 to 1930, there was a warming of 2.5°F, followed by a cooling of about 1.5°F up until 1980. Since 1980 warming has resumed, but it is too soon yet to tell if this is a continuing trend or just a brief fluctuation. Detecting a true shift in the climate of Illinois is very difficult because of the random fluctuations in our climate that last from five years to several decades, according to Changnon.

While the Water Survey's written records go back 100 years, scientists can estimate past climate conditions using natural records. Measuring the width of tree rings can tell a lot about the temperature, precipitation, and flood history of an area. But, as Wendland points out, "only a few trees in Illinois are older than 200 years." To get into the more distant past, scientists can study the sediments that settle each year in bogs or lakes. Bog cores in Illinois preserve pollen, which can reveal the vegetation record as far back as 12,000 years. Geologic records allow us to estimate the climate as far back as 200,000 years.

> **"The problem with the word 'global' is that most people don't think it's something they have to worry about here at home."**
>
> Stephen Vermette, Assistant Director of the Global Climate Change Program.

The Greenhouse Effect

The earth's climate is always changing. When dinosaurs lived here, the global temperature was a steamy 27°F warmer than it is now. And when northern Illinois was buried in ice 12,000 years ago, it was about 9°F colder.

Scientists don't completely understand how various factors interact to cause major climate shifts; however, recent evidence suggests the importance of shifts in cloud-cover, changes in the orbit of the earth around the sun, and volcanic eruptions. (Mt. Pinatubo's eruption in 1991 led to a much cooler summer in 1992 than was expected.) Some human activities may also have a global impact—for example, by releasing CO_2 and other trace gases into the atmosphere. This last phenomenon is a component of global warming, or the greenhouse effect.

The greenhouse effect is really a natural process that has been going on for millions of years. It involves certain trace gases in the atmosphere which help keep the earth's temperature at a "livable" level. These gases act somewhat like the glass panes of a greenhouse, letting the sun's warming rays pass through to the earth and trapping some of the infrared energy that is radiated back upward. As a result, the earth is kept 45-54°F warmer than it would be if no "greenhouse gases" were present.

"Without the greenhouse effect, we couldn't survive," says Vermette. "It would be too cold." He explains that global warming is really an *enhanced* greenhouse effect caused by human activities. Over the last century, the atmospheric concentration of CO_2 has increased 25%—largely due to the burning of coal and oil for energy. Other greenhouse gases produced by civilization include methane generated by rice growing, feed lots, and landfills; nitrous oxide emitted from autos, trucks, and chemical fertilizers; and chloroflurocarbons

(CFCs), used as refrigerants. The United States contributes 21% of the world's greenhouse gases to the atmosphere and about 1% of the global total comes from Illinois.

Common sense tells us that adding more greenhouse gases to the atmosphere will cause the atmosphere to heat up. But, as Vermette explains, we don't yet know how this will impact the global climate or, equally important, the regional climate. "What we're concerned about, of course, is the amount of change in temperature, rainfall, storms, and all other weather conditions, as well as just how rapidly conditions will change."

Changnon asks key parallel questions: "How well can environmentally sensitive species and other physical conditions adjust to the likely changes? And can our society adapt to these changes—or will we need to reduce gas emissions to minimize the negative effects?"

Working Together to Study a Global Issue

To find the answers to these questions, the Water Survey is soliciting input from specialists around the country. "Our major objective is to pull together our scientists and those in other disciplines to tackle an environmental issue that involves water, weather, biology, agriculture, politics, industry, and more," says Changnon.

Several of the research projects are designed to study the impact of climate change on a regional scale. One of these is the development of future climate scenarios for the Great Lakes region. In collaborative efforts with the Great Lakes Environmental Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA), Water Survey scientists are using a computerized hydrologic model of the Great Lakes to see how different climates might affect the level and supply of water in the lakes. To test the effects of a warmer, wetter climate, they are using 40 years of weather data from Alabama and Mississippi—and plugging them into the Great Lakes hydrologic model. To test a warmer, drier climate, they are using data from Kansas and Oklahoma.

"Global climate change represents the single greatest environmental threat that humans have created."

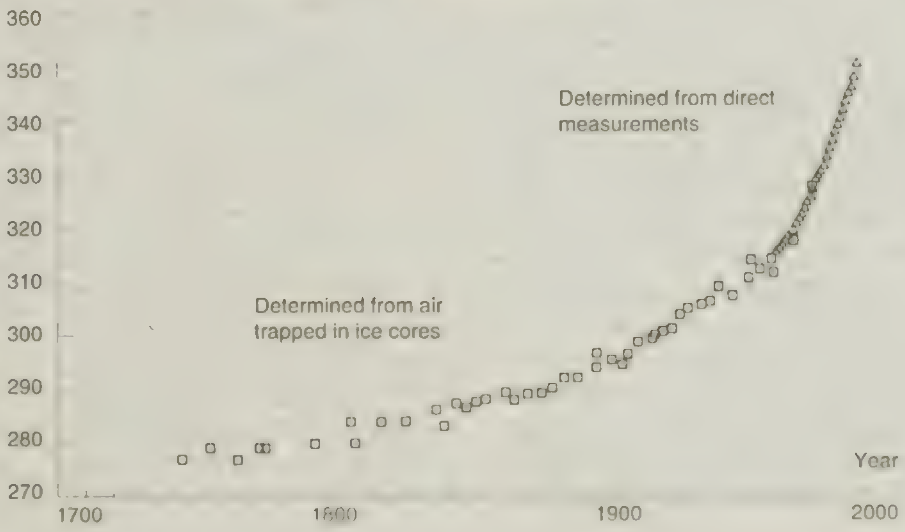
Stanley Changnon, Director of the ISWS
Global Climate Change Program

So far this project is exploring only the physical effects of climate change. But Changnon wants to look at the social and economic impacts as well. "We have to take the next step," he says. "If the climate changes, what will happen to lake transportation and shipping? What will happen to shoreline interests around the lake—the harbors and private properties? How should owners and our government respond? This is the kind of research we hope to launch in the future."

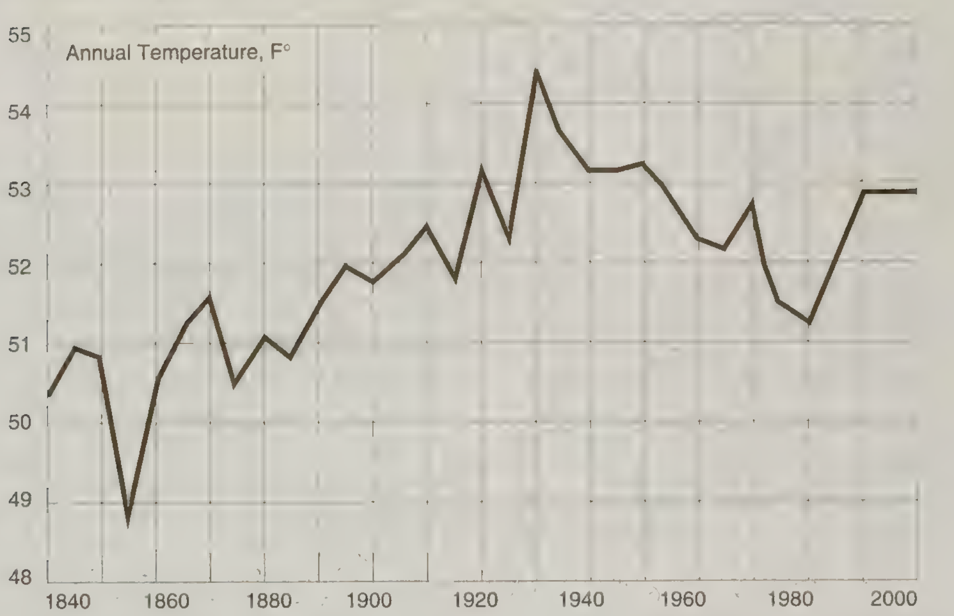
Some of the current Water Survey research is focusing on the causes of localized climate change. Human activities have already created notable local and regional changes in climate. For example, one project is looking at how a major heat-generating city like Chicago affects its local climate. Another project is analyzing the effect of jet contrails on cloudiness and atmospheric temperature. (Evidence strongly suggests that jet contrails along the east-west flight corridor across the Midwest have caused a 20% increase in cloudiness over the last 20 years.) This factor could reduce surface temperature by deflecting some of the sun's radiation before it reaches the earth. Other projects consider the agricultural, economic, and social impacts of climate change: how corn yields are affected by changes in the water supply; how urban governments in the Great Lakes region have historically responded to climate fluctuations; and how we can develop an Illinois action plan for greenhouse gas emissions.

Projecting the economic impact on large cities is a vital part of global climate change research, says Changnon. "Seventy-five percent of our populace lives in major metropolitan areas. We need to provide good evidence of what a change could mean to people. Would it mean poorer or better health? What would warming cost each person? $5 or $10 per year?

Atmospheric CO_2 increase in the past 250 years



Greenhouse gases are on the rise. Over the last century, the atmospheric concentration of CO_2 has increased 25%, largely due to the burning of coal and oil for energy.



Illinois Temperature (5-Year Mean Values) 1840-1990

How has climate changed in Illinois? From about 1887 to 1930, there was a warming of 2.5°F followed by a cooling of about 1.5°F until 1980. Since 1980 warming has resumed, but it is too soon yet to tell if this is a continuing trend. The temperature trends for Illinois hold true for North America and the Northern hemisphere as well.

If you can't estimate the economic impact, then you cannot provide the policymakers with enough incentive to take action." With this in mind, Changnon, a group of scientists, and Chicago and state officials are currently planning a major research project to study how changes in climate might affect the Chicago urban area. They will also be looking at what actions, such as energy conservation, might help minimize the growing greenhouse effect.

Educating the Public

In addition to conducting research and monitoring climate change in Illinois, the Water Survey is charged with "disseminating information" about the issue to a broad audience, including scientists, policy makers, and the general public. Heading up the Information Team is Vermette, who lectures on climate change to people of all ages and backgrounds.

Last fall he spoke at a meeting of the Illinois Science Teachers Association. "Science teachers are interested in the global climate change issue because it touches every discipline," says Vermette. He tries to help teachers explain the greenhouse effect and other climate concepts to children using simple analogies and stories. For example, the enhanced greenhouse effect is like getting into your car on a hot summer day when all the windows are shut, or like wrapping blankets around the earth. The more blankets (pollutants) that we add to the earth's atmosphere, the warmer it gets.

To teach children how important our atmosphere and the greenhouse gases are to life on earth, Vermette uses a story he calls "The Tale of Three Planets." It's sort of a take-off on the classic "Goldilocks," with three different planets—Mercury, Venus, and Earth—replacing the three bowls of porridge. Mercury has no atmosphere to hold the temperature constant, so when the sun goes down, it's "too cold." Venus, with an atmosphere composed of as much as 90% CO_2, is way "too hot." (It's an example of global climate change gone wild.) Earth, with its atmosphere of oxygen, nitrogen, and just a little CO_2 and other greenhouse gases, is "just right" at a comfortable average of 60°F.

"In not too many years, these children will be adults," he says. "And it will be just about the time when bills will be introduced in Congress and global agreements will be starting. They will be informed—from a very early age—about climate change and its possible impacts, so that they can make informed decisions about the necessary laws."

As part of its public and technical information efforts, the Water Survey publishes scientific papers and sponsors conferences designed to create a multidisciplinary forum for discussion. Global climate change researchers are already working with scientists from the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Illinois Department of Energy and Natural Resources, and several universities. The Survey is also reaching out to the business community. A Global Climate Change conference held in late October provided an "economic and business perspective" on the global climate change issue. (See "Currents" on page 12.)

"We hope that, by providing these forums, there will be more dialogue, more research, more information, and, ultimately, a better understanding of the issue," says Vermette.

The Water Survey has a database that is among the best-documented in the world, making it an ideal place for climate change research.

"The future climate, even without the enhanced greenhouse effect, is certain to be somewhat different than it has been in the last 20 to 50 years, due to natural fluctuations," says Changnon. "We have developed a lifestyle within the constraints of climate. When climate fluctuates just a bit, even today, there are losses. We must get ready so we can develop sound strategies for the future." ■

Carolyn Arden Bresler is a science writer and director of media relations and publications for The Chicago Academy of Sciences.

NORTHWEST ADVENTURE

by Diana Milesko-Pytel

Northwest Illinois makes myth of the notion that the entire state is flat.

The whole world is empty except for the biker gliding downhill ahead of you. A mist locked in low pockets of the hollows contrasts with the sweet and brilliant sunlight that is sharp and warm on your face. Following the dots on the highway fills you with a strange and foolish joy. This is the biking you came for.

Geology: A Visceral Experience

Northwest Illinois makes myth of the notion that this state is all flat. Pleistocene glaciers, which invaded and produced a smooth landscape almost everywhere else in the Midwest, left this area untouched. The resulting topography and abundant flora and fauna make biking, hiking, and flower and bird watching unique.

This "driftless region," which escaped the many glaciers rumbling through the region, extends north along the Mississippi to LaCrosse, Wisconsin, south to Savanna, Illinois, a few miles into Iowa, and to the east side of Jo Daviess County.

Geology is more than a big word when you hike or bike here. It's a visceral experience—the ache of your calves as you climb a steep hill, the sweat on your brow cooled by a river breeze, the exhilaration of a long coast downhill, punctuated by frequent braking to stay within the speed limit. Here you live the geology.

Years ago when my spouse, Frank, and I first passed through the area, we decided its dips and climbs would be a vigorous workout for avid bikers. We are past our "avid" years, but a weekend here suits our slower style as well. Hiking in the Apple River Canyon, Mississippi Palisades State Park, and Galena Territory, and biking along the Mississippi River, we find nature easy to enjoy.

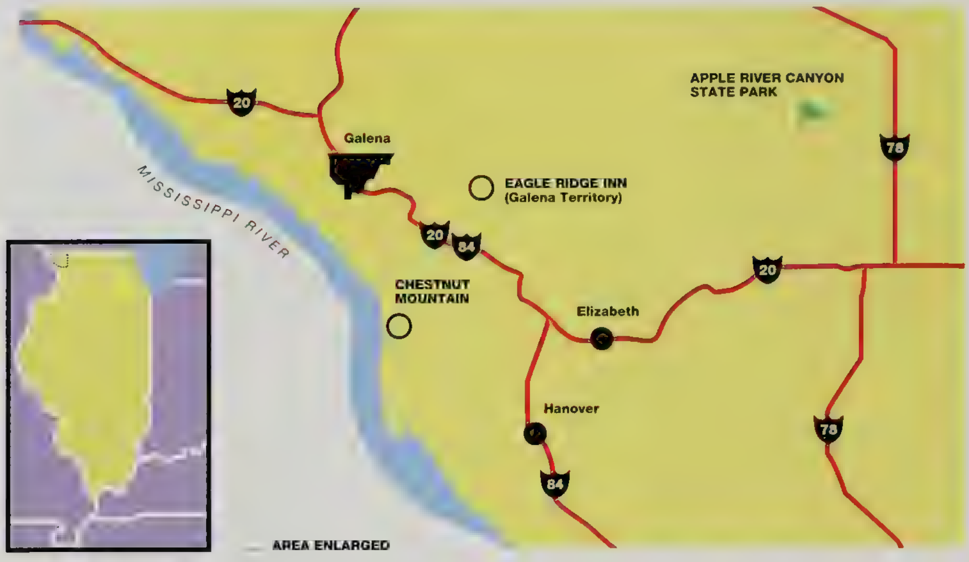
In May, we follow the Primrose Trail of the Apple River Canyon and climb an ancient cliff whose walls, from the Ordovician age, are 400 million years old. Hundreds of feet below, near the chuckling river, the tiny bird's eye primrose, a relic of prehistoric times, dots the canyon ledges with delicate pink flowers.

Further west, in the Galena Territory, eastern bluebirds nest in trail boxes erected by the Eagle Ridge Inn. The blue flash of color on the male bird in flight takes our breath away.

At the southern edge of the driftless region, in the Mississippi Palisades Park, delicate shooting stars and Dutchman's breeches, and larger Virginia bluebells and trillium carpet the hills along the Sentinel Trail. Fifty feet away, across a deep chasm, rock climbers test their strength and nerve on dolomite towers formed aeons ago.

Yes, the terrain here is special. Dr. John Bouseman, an entomologist at the Illinois Natural History Survey (INHS) and resident of the area, describes one of his favorite landscapes. "West of Elizabeth on Route 20, the terrain creates an optical illusion, as if the hills are sloping in towards you. You're on a ridge, but it feels like you're in the middle of a saucer."

Elsewhere, in fields, giant boulders seem to be slowly sliding downhill. Jim Quick, a nature enthusiast, says, "That's exactly what they're doing. Caprock of dolomite sits on top of the more easily eroded Maquoketa shale."



A map of Jo Daviess County

As the shale, covered by soil and grasses, weathers apart, the caprock becomes unsupported and breaks off. Then, taking thousands of years, it creeps down the hillside. Everything here goes a pace slower.

Steep Hills, Winding Roads

This land, where the horizon is just a hill away, is great for hearty bikers. But it can be enjoyed as well by hikers, and "casual cyclers," who go a little slower and see a lot more.

Biking out of Galena on Blackjack Road, which parallels the Mississippi River to Hanover, we see a road sign, "Be Alert. Winding road next 14 miles." It doesn't exaggerate.

In May, traffic is light. (October, with its fall colors, is the busiest month.) This "sheep in the meadow, cows in the corn," kind of scenery conjures up images of the headless horseman, Ichabod Crane, galloping through spooky hollows. Two miles down the road, near Chestnut Mountain, Sugar Camp Hill rises relentlessly—proof that glaciers did not level the area. We walk our bikes up the hill, stopping often to rest and take pictures.

For the next six miles the road follows a gently contoured ridge. Bucolic scenes of pasture and forest are visually restful; physical rest comes as a long, gradual descent leads into a valley.

Members of the "High Pointers Club" bike to Charles Mound, located on a crop field. At 1,235 feet, it has no distinguishing characteristics, but the club's goal is to bike to the highest point in as many states as possible. Other cyclists come to northwest Illinois individually and in groups, from as close as Galena and as far away as Russia. They are all ages—from 7 to 70—and come rarely or regularly.

A male eastern bluebird calls to his mate in a fledging box at Eagle Ridge Inn. (Photo by James Quick)

The Tour of the Mississippi River Valley (TOMRV) rides through Galena every June, biking up one side of the Mississippi and down the other. Another favorite with hearty bikers is the Stagecoach Road from Galena to Warren. Those seeking less traffic try the Galena Territory, where roads wind along golf courses, and most return to the same point.

On the Bluebird Trail

In spring and fall, northwest Illinois is part of a major flyway for migrating birds following the Mississippi River. One bird making a comeback in the area is the eastern bluebird.

Barbara Siekowski and Jim Quick, members of the Natural Area Guardians, monitor a bluebird trail, a series of boxes 100 yards apart, at the Eagle Ridge Inn near Galena. "One reason the bluebird declined was lack of nesting sites," says Barbara. "A cavity nester, it built its nest in rotted trees or wooden fenceposts." Many of these have been replaced with steel fencing. "Also contributing to its decline were chemicals sprayed on lawns to reduce broad leaf weeds. The bird, which is a ground feeder, ingested chemical-covered insects."

Barbara keeps a weekly log on the bluebird trail. Installed in 1991, the boxes fledged 22 birds their first year.

"This place is ideal for the birds, who prefer a mixed habitat of mowed lawns, longer grasses, and trees with open branches for parents and fledglings to perch," says Jim. Fledglings may stay on their first perch for a week or more.

Not to be confused with the noisy blue jay, the male eastern bluebird has a blue back and wings, and a red breast. The blue on its back is an astonishing, flamboyant, shouting blue. "It is electric, like it's plugged into a wall socket," says Jim. The bird has more than color to

A rainbow frames the countryside on Route 84 between Savannah and Hanover.

commend it. A smaller cousin of the robin, seven inches to the robin's nine, the bluebird is a thrush.

"These are familial birds. If one parent is killed, the other will not abandon the nest." Bluebirds are capable of raising two and three broods in a season, and first fledglings often help raise the second brood.

Before the bluebirds arrive, Jim cleans ant nests out of the boxes and sees that invasive species such as house sparrows, European birds introduced to North America, haven't nested in them. Later he checks that cowbirds, also a European bird, haven't laid eggs in the nests for the bluebird to hatch and raise.

Barbara records the number of bluebird eggs, keeps track of how many become hatchlings, and how many fledge. The birds are accepting of all this human intervention. "I've heard of cases where the person has to lift up the brooding female to count her eggs," says Jim.

Last week, the first box had three eggs; today it has five. The female generally starts to incubate when there are five eggs.

A wren has beaten the bluebirds to the next box and has started a nest. Jim leaves the sticks untouched. Wrens, like other native songbirds, are protected by law. The box is not ideal for bluebirds anyway. "This habitat is a little too bushy. We left the box up so wrens and chickadees wouldn't compete for the better bluebird boxes."

Barbara says, "Chickadees have about nine eggs; they make the most beautiful cradle of moss."

In the next box they find five two-day-old bluebird hatchlings. "We leave a window closed from 13 to 18 days after the chicks hatch," says Jim. "We don't want to disturb the feedings or startle the young." Chicks fledge at about 14 days. "In some cases, on a first flight, they'll go as far as 700 yards. That's like getting your driver's permit and heading out on the Kennedy Expressway in Chicago!"

Dr. Scott Robinson, ornithologist in the INHS Center for Wildlife Ecology, says that most songbirds live for two to four years. Their migration journeys are arduous, and when they arrive in their wintering grounds, they often find their habitat has been destroyed.

"Bluebirds do not make long flights deep into the tropics. They are short distance migrants, usually traveling between 100-150 miles. "Their wintering grounds are mostly in the gulf coastal grasslands and marshes, and in the last few decades, that area has undergone a dramatic conversion to rice, corn, and soybeans. It is one of the most rapidly disappearing habitats in the country. Though they can live eight to ten years, the average bluebird probably has only one breeding season."

"Increasingly, we're coming to recognize that a lot of birds in trouble in the East are those that winter in what used to be the coastal grasslands." The coastal grasslands areas include parts of East Texas, Mississippi, Arkansas, and maybe a bit of Georgia, that once had extensive areas of grassy shrubs, marshes, and

Soil and grass-covered Maquoketa shale erodes, exposing caprock of dolomite boulders. (Photo by Diana Milesko-Pytel)

bayous. Perhaps that is why some bluebirds winter in Jo Daviess County. But even then, their fate is not secure. Ice storms, bitter cold, and deep snow that keeps the food supply covered kills many bluebirds that try to winter up north.

It is evident that Barbara and Jim enjoy talking about bluebirds. "It's a way to educate people to the value of creatures that are part of our natural heritage," says Barbara.

Recently, Jim lent a curious tourist his binoculars. "He was overjoyed. As a child on Long Island he loved bluebirds, but they disappeared from the area. He hadn't seen a bluebird in 30 years. "People have these links to nature that are deeply meaningful to them. They are more than just childhood memories. They are ties to something innocent in their lives."

The Galena and Apple Rivers

Rivers are corridors of distribution, not just for plants and animals, but for people as well. Galena, a town whose name means "lead sulfide," sits along a river that empties into the Mississippi. A hundred years ago it was a busy river and mining town. But the mines were shallow, and the railroad stole away the river traffic. Galena's population shrank, and so did the river.

Flowing at the foot of the business district, the river once brimmed with packet steamers and paddle wheel boats. "Now it's all you can do to turn a rowboat around," says Bouseman. Silt from the surrounding farms choked the river, and dams on the Mississippi bound the streams. "The only time there's much movement of water is when there's a lot of rainfall. But even that's not enough to flush it out."

Dr. Lawrence M. Page, director of the INHS Center for Biodiversity, recently completed an assessment of biologically significant streams in Illinois, including the Galena and Apple rivers in the northwest part of the state. "You can judge water quality by the diversity of clams in the river bed. They are like the canary in a mine. Many are intolerant of silt. "Both the Galena and Apple rivers suffer from siltation and barnyard pollution.

"The Galena has not been sampled for mussels, but it's not in as good shape as the Apple. There are three documented species of fresh water mussels in the Apple River. I suspect there are more, but we need to go in and look around. Surprisingly, there are some forms of life in the Apple River that are not found elsewhere. I'd like to see more of the Apple preserved, and the Galena

Built on a hill with steep streets, much of the town of Galena has been restored. It is known for its many antique shops, restaurants, inns, and B&Bs.

restored. The Sierra Club is working at the state level on how to write legislation to best protect our streams."

Bird's Eye Primrose

A tiny pink flower, the bird's eye primrose, grows on cliffs both in the Apple River Canyon State Park and farther upstream, outside the park boundary. "It prefers moist, narrow shelves such as a river canyon wall," says John Taft, INHS staff scientist, who specializes in flora. "Moisture from the river saturates the limestone cliff face." The primrose distribution is from Labrador, west. In Illinois it appears at the southern edge of its range. Though delicate-looking, it is a durable flower.

"Plants occurring in their southernmost range in Illinois are often relics of cooler Pleistocene climatic conditions. Northern flora migrated south with the advancing glaciers. As the glaciers retreated, some plants found a niche, and survive today. "After the Ice Age ended about 10,000 years ago, the primrose survived a period of hot, humid climate, the Xerothermic Period, which ended 4,000 years ago."

Remnant Prairie

When Barbara and Jim were asked by the Eagle Ridge Inn resort to do an inventory of wildflowers in the Galena Territory, they expected to find perhaps 50 species; they found more than 200. They also discovered a remnant prairie, less than an acre in size. "It's not absolutely virgin, but it has prairie plants and flowers," says Jim. "It's in its glory in late summer and fall. In May it looks like an unkempt lawn." With roots that go down ten to 16 feet, prairie can survive drought; fire helps it by retarding woody growth, shrubs, and trees.

A larger prairie near Chestnut Mountain is being restored, ten acres at a time, by the Natural Area Gardening Group. The whole complex, donated by private individuals and the state, is about 1,000 acres. When finished, 100 acres will be prairie.

Apple River Canyon State Park remains a natural, undeveloped area with primitive facilities.

It is a paradox, perhaps, that this area, which predates ancient glaciers, is undergoing a kind of rebirth. Birds are returning; prairies and rivers are being restored; even the town of Galena is being revitalized. And that is good. For the land here is evocative of a simpler, more innocent time. The landscape, birds, and flowers have put our hectic, citified lives in perspective.

When we leave, it is with a deep sense of gratitude and rejuvenation. The bluebirds and shooting stars, the hills we biked and cliffs we climbed, have given us a better appreciation of what Barbara means when she says, "Nature is incredible. It's a wonderful thing to study all your life." ■

Diana Milesko-Pytel sails, bikes, hikes, and writes her way through the great out-of-doors. A regular contributor to local and national publications on health, education, and the environment, she teaches college students and gives seminars on such topics as critical thinking and communications.

For information on accommodations, events, and natural areas in Jo Daviess County, call the Galena-Jo Daviess County Convention & Visitors Bureau (800) 747-9377.

Photos by Joel Dexter except where indicated

DIGGING FOR KNOWLEDGE

by *Jean Gray*

"You do the best darned geology you can and promote its application to meet human needs."

John P. Kempton, Senior Geologist and Head of the ISGS Quaternary Framework Studies Section

For nearly 40 years John Kempton has been involved in doing some pretty darned good geology at the Illinois State Geological Survey (ISGS). Currently, Kempton and his ISGS team are in the second year of a three-year cooperative venture with the US Geological Survey. They have just completed a drilling and sampling program, building on what has been learned in the past about what lies beneath the ground in Illinois. Using up-to-date technology and computer mapping techniques, they will refine what is known about that section of Illinois known as the Champaign 1:100,000 Quadrangle. When the job is completed, the ISGS will produce maps that will tell a story about a 1,900-square-mile area covered by glacial deposits averaging 250 feet thick and about two million years old.

The Champaign Quadrangle was selected as the pilot study area by Dr. Kempton and Drs. Richard C. Berg (ISGS) and David R. Soller (USGS) because its geologic diversity makes it ideal for developing and evaluating techniques that will help set future standards for state-of-the-art three-dimensional Quaternary mapping. (Quaternary refers to the period since the beginning of the last major geological period, one to three million years ago, during which continental glaciation was extensive.) Quaternary materials laid down in Champaign County range in thickness

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Drilling near Foosland, one of four key locations in the Champaign 1:100,000 Quadrangle, produced cores from the surface of the earth down to bedrock. "The idea," says Kempton, "is to fill in the blanks of what we know from well drillers' logs, previously collected core samples from highway and other construction sites, and existing maps so we can describe the nature and distribution of materials at and below the earth's surface."

Glacial till meets sand and gravel at a contact point in the core. Preliminary interpretations, made in the field, help geologists know what to expect in the next core drawn from the earth.

from 50 to 500 feet and range in composition from organic materials to thick glacial pebbly clay (till) to sand and gravel (outwash). The area contains a major sand and gravel aquifer as well as several less extensive, but locally important, aquifers.

A serious gap exists in Illinois and the nation in the availability of large-scale, detailed geologic maps for solving everyday earth-related problems. These maps are needed to describe the nature and distribution of earth materials at and below the earth's surface. This pilot project of the USGS and ISGS will eventually lead to a state mapping program at a scale of one inch equalling 2,000 feet (1:24,000). Less than 20% of the nation and only about 3% of the state have been mapped at this scale.

"We want to go as deep and learn as much as we can," says Kempton. These basic geologic maps can be interpreted for land uses such as: siting construction projects; selecting sites for highways and landfills for municipal and low-level radioactive wastes; developing zoning regulations; locating and protecting groundwater resources; identifying areas that might be sensitive to over-application of agricultural chemicals; and locating resources such as sand and gravel. The ratio of benefits to costs has been quantified by the ISGS at about three-to-one in a study of mapping in Boone and Winnebago counties. (See "Geologic Mapping Pays!" *The Nature of Illinois*, Fall 1991, page 11.)

The Geologic Mapping Act, signed by President Bush in 1992, calls for a national geologic mapping program with the USGS as lead federal agency working in association with the states and territories. Illinois has contributed $135,000 to the current project, an amount matched by the federal government. ■

Core samples are described, carefully wrapped, labeled, and sent to the lab for more detailed description, analysis, and interpretation. The small tins contain representative samples cut from the cores and sealed for added protection. They will be measured later for moisture content.

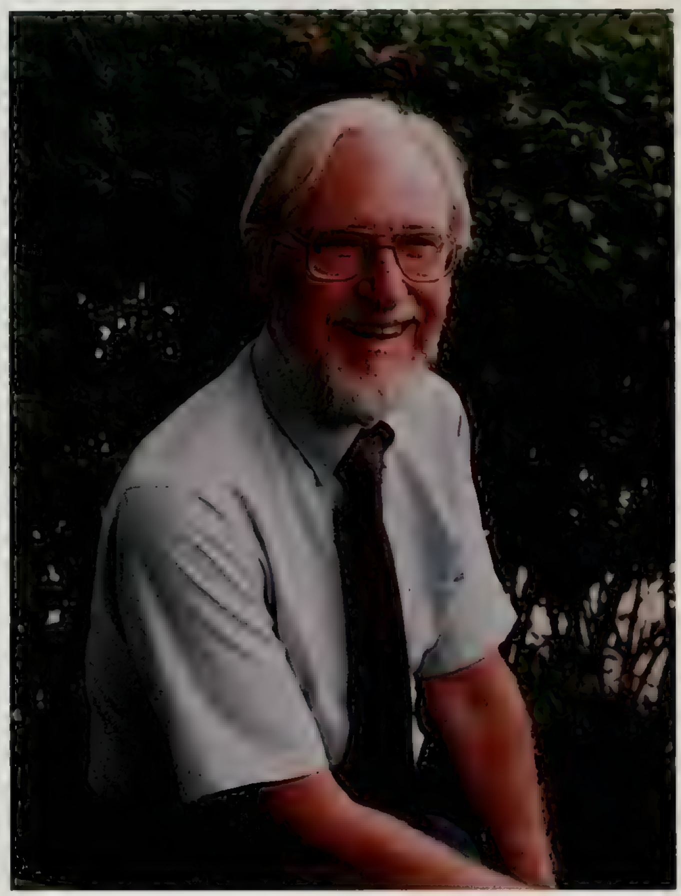
Photos by Joel Dexter, ISGS Graphics and Publications Unit

Dr. Kempton and geologist Myrna Killey explain field notations to ISGS staff members. ISGS team members in the field also take time out to teach informal geology lessons to visiting school classes

A New Chief for the Water Survey

John T. O'Connor assumed his new post as Chief of the Illinois State Water Survey last September and within a month was addressing a standing-room-only audience at the third annual William C. Ackermann Distinguished Lecture Series on Water Resource Issues. His topic: "The Water Survey: Its Contributions to the State and the Nation—Past, Present, and To Come."

Although he prefaced his talk with the admonition that he was "new on the job" and would welcome those more knowledgeable to teach him about the Water Survey, there was no question at lecture's end that the new chief knew exactly where the Water Survey had been, how it had developed over the years, and where it should direct its energies in the future.



Chief O'Connor: "I'm really impressed with the people at the Water Survey, their tradition of excellence and strength of purpose. As for the laboratory facilities, they are some of the finest in the nation—even in the world." (ISWS photo by Linda Hascall)

Dr. O'Connor comes to the Water Survey from the University of Missouri at Columbia (UMC), where he had been a member of the research and teaching faculty of the Department of Civil Engineering since 1975. There he served as professor and department chair, with several appointments to the C.W. LaPierre Professorship of Civil Engineering. His most recent publications have focused on the chemistry of drinking water and water treatment.

You Can Go Home Again

Prior to his tenure at UMC, Dr. O'Connor spent nearly 15 years on the civil engineering faculty of the University of Illinois at Urbana-Champaign, where he attained the rank of professor.

Now, back in Illinois, O'Connor intends to deal forthrightly with difficult issues such how to assess and deal with Atrazine (a chemical fertilizer which has been a bounty to Illinois agriculture but a growing factor in groundwater and stream contamination) and developing methodologies to chart the best course for a defensible low-level nuclear storage facility. Perhaps one of the most difficult issues O'Connor will face is how to compete for private, state, and federal grants to enhance the Water Survey's ability to continue to excel in the face of shrinking state general revenue funds.

O'Connor recognizes that after his 17-year absence from Illinois, he returns at a time when environmental concerns appear to be at odds with economic concerns: "It shouldn't be that way," he says. "Long term degradation of the environment produces ***dis***economy. Conservation is not the enemy of business—it makes the delivery of goods and services more efficient. Sound environmental policy should be a handmaid of the economy, a helpmate to enterprise."

A New York native, Dr. O'Connor holds a bachelor's degree in civil engineering from The Cooper Union, New York; a master's degree in civil engineering from the New Jersey Institute of Technology; and a doctorate in engineering from The Johns Hopkins University, Baltimore.

Dr. O'Connor has been the recipient of a Fulbright Fellowship and the Simon A. Freese Award and Lectureship from the American Society of Civil Engineers. He is a Fellow of the American Society of Civil Engineers, a Life Member of the American Water Works Association, and a Member of the American Chemical Society, the Water Pollution Control Federation, the American Society of Limnology and Oceanology, and the International Association of Water Pollution Research. He is a registered professional engineer in Missouri, New York, and Illinois.

The new chief, the seventh in the Water Survey's 98-year history, succeeds former Chief Richard G. Semonin, who retired in December 1991, and Acting Chief Mark E. Peden, who served in the interim. ■

Laurie Talkington
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